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The Printing Exhibition.

THE eighth International Printing and Allied Trades Exhibition, which is referred to elsewhere in this issue, affords a remarkable insight into the progress of both the art of printing and of printing machinery. The exhibition gives an exceptionally complete idea of most of the well-known makes, both home and foreign, of printing press, ranging from the small jobbing press to newspaper presses of the largest size, besides all kinds of accessories.

From the electrical point of view the progress of electrical accessories is very marked. An ingenious electric furnace for keeping type metal molten, which we understand will shortly be manufactured in this country, for instance, is noticeable, but of course the main electrical problem of printing work is the drive. A variable-speed drive is a necessity, or at any rate an advantage in most cases, its importance growing with the increasing size of the plant. The other main electrical problem of printing-press work is automatic control, and while one notices the increase of pillar-type automatic controllers for small motors, this is chiefly a problem of the large newspaper press.

Returning to the subject of variable speed, it is noticeable that the old nervousness of the commutator machine, which blocked its progress for so long, seems to be yielding to experience. Dealing first with the small sizes, several commutator machines are shown, usually of the repulsion type, the brush shift by which the speed is regulated being accomplished either by a small pilot motor, or by a lever and flexible wire from a short distance. In this connection attention may be drawn to two very ingenious variable-speed gears which may well find a considerable field of application alongside the commutator motor. One of them provides a large number of distinct steps at small intervals, and the other truly continuous variation of speed combined with positive drive. The movement in favour of quantity production of small constant-speed motors at low prices is very strong, as most of us know, and this favours the use of a gear.

Coming to the larger sizes, the problem before the designer of the electrical equipment is to provide apparatus which will run for inching purposes at as low a speed as 12 r.p.m. and will give perfectly steady and

regular acceleration under full automatic control from that speed to perhaps 700 to 800 r.p.m. The need for absolutely steady acceleration of course arises from the delicate nature of the paper band on which the type roller acts, which would break if any jerk were applied to it.

The inching speeds are still obtained, as heretofore, by the use of a pony motor driving the press through a "free wheeling" device, so that as soon as the main motor exceeds the speed of the gear driven by the pony motor, the "free wheel," which is a ratchet device, engages, and the main motor takes up the load. With direct current no serious difficulty arises in obtaining speed variation with regular acceleration from the lowest speed at which the press is required to run continuously to the highest, which means a speed range of three or four to one. This is effected by shunt control, and several examples are shown at the exhibition, which do not, however, present any striking developments.

With alternating current it was customary a few years ago to use an induction motor with resistance control, the motor only operating with resistance entirely cut out when driving the press at its highest speed, a speed which might not be required perhaps more than once a week, or so, for stop-press editions. Consequently the electrical equipment always consumed the same power as it consumed at top speed, and the difference was wasted when running at lower speed. Having in view the large number of printing works operated on this plan, it is impossible to deny that it gave satisfactory service from the printer's point of view. This method of operation, always rather shocking to the electrical engineer, now seems to be going out of favour, no examples, so far as can be judged, being shown at the exhibition.

Commutator machines of considerable h.p. are now being shown. One of them is of the well-known Schrage type, the primary current being led into the rotor by slip-rings, the rotor carrying a commutator on which two sets of brushes rest that are capable of movement in opposite directions, the movement being effected by means of a small pilot motor. The machine has a shunt characteristic, and its speed therefore varies very little between no load and full load for a given setting of the brushes. This is, however, in reality, of less importance in printing-press work than for many other applications, since a printing-press load consists almost entirely of the friction of the large mass of machinery and of the paper passing between the rolls. It is as steady a load as one can well imagine, and therefore extremely well adapted to a motor having series characteristics.

The other large commutator motor exhibited is of this type, being substantially a three-phase series motor in which the brushes are connected in series with the stator winding, the voltage being reduced by a transformer to a value adapted to secure good commutation. Both types of alternating-current motor carry out the inching operation by means of a pony motor as just described.

The other problem which faces the designer of electrical printing equipment is that of full automatic control. The printing press must be operated by means of a set (usually four) of push buttons, which are duplicated at various parts of the press, so that the operators can control the press from wherever they happen to be working. In addition, a large press is made in sections, and it is necessary that one section be capable of being made dead while work is proceeding on others. This leads to extremely complex control gear, which has, however, been worked out successfully for all the different kinds of drive. The absence of resistances, and the fact that control is effected by means of a pilot motor moving the brushes, tend to make the switchgear used with the commutator motors somewhat simpler than that of other types.

Though, strictly speaking, not of electrical interest, one cannot help being impressed by the many beautiful examples of colour printing shown and, in particular, by some beautiful results of the new process of colour photography now being developed.

Load Building.

In the United States the development of electricity has proceeded so far that the main work of the supply companies is not extension, but intension, *i.e.*, the cultivation of increased consumption for expenditure already incurred. That is the principal difference between conditions in the States and in this country. Here, only about one sixth of the houses immediately available are wired for electricity, and extension must still remain a very important part of the supply authority's work. That, however, does not preclude special efforts to make the most of what they already have, and in this respect the article on electrical merchandising, by Mr. S. M. Kennedy, which we print in this issue, is very apposite, although written from the American point of view. Mr. Kennedy has had considerable experience of electrical development work in the United States, having been vice-president in charge of business development and public relations of an important American public service company.

Although due allowance must be made here and there for differences between British and American ideas and practice, it is certain that the fundamental truths remain unaffected by these differences. The problem is the same in each country (as in every other country): how to interest, educate and retain the consumer; and, as human nature is much the same all over the world, the methods of dealing with the problem cannot be very dissimilar.

Therefore, we consider that Mr. Kennedy's article is a useful study of the subject of selling electrical appliances, which, although it may be considered elementary in places, really gets down to basic facts upon which practice, whether British or American, has to be built.

Underground or Overhead Cables?

In his paper on electricity in agriculture, with special reference to electroculture, recently read before the Western Centre of the Institution of Electrical Engineers, and abstracted in our April 12th issue, Mr. W. Phoenix, A.M.I.E.E., again stresses the desirability, whenever economically possible, of adopting underground distribution for rural areas in preference to overhead, and of considering every possible method of cheapening distribution schemes employing underground cables.

The advantages of underground mains for low and medium voltages over air lines are well known, and great prominence—perhaps too much—has been given in recent years to the short-comings of overhead lines in respect of the æsthetic consideration and the point of view of decreased factors of continuity of supply and general security; but the one and most important consideration which nearly always turns the scales in favour of the overhead system is economics.

It is particularly interesting to recall that in the large rural area of the Bedford electricity undertaking (Electrical Review, May 27th, 1927, p. 834) underground cables in most cases have been found to be an economical proposition, and that, among others, Mr. G. Porter (Worthing), and Mr. R. W. L. Phillips (Bedford), during the discussions at the I.M.E.A. Convention at Bath last year, expressed the belief that underground cables could be laid and operated ultimately as cheaply as overhead lines.

It is not suggested that a case has been proved against overhead lines—far from it—or even that underground cables can be adopted at present for many rural distribution schemes, but it is strongly urged that the underground system should not be definitely "shelved," and that efforts should be continued to make possible the use of conductors below ground. As Mr. Phoenix points out, much can be saved by the use of multiple service boxes and eaves cables where houses are situated in blocks, and road-reinstatement charges are much less, generally, in rural districts than in towns. Considera-

tion should also be given to the possibilities of using rubber-sheathed and other less costly types of cables buried.

If underground distribution can be made economically possible in country districts, then one big obstacle to rural electrification will be overcome, and the result will be more in keeping with the tradition of this country in respect of the soundness and reliability of her engineering.

High-Voltage Cable Development.

In a paper on this subject presented at the recent Convention of the American Institute of Electrical Engineers, Messrs. E. W. Davis and W. N. Eddy state that reliability of insulation quality determination is essential to satisfactory progress in high-voltage cable development The most reliable test available at present for this pur pose is the over-voltage life test, but there is some evidence that it may not always give a true indication of insulation quality. Efforts are being made to increase its reliability by causing failure on test by the exaggeration of the causes of failure in service. rather than by increasing the operating voltage alone. While the ionisation test is usually in fair agreement with the over-voltage life test as an indication of insula tion quality, there are some instances, such as that of a re-saturated cable, in which an indication of quality by the ionisation test is not confirmed by the life test. The air resistance of the paper used has a material influence on the insulation quality of the completed cable, regardless of whether the paper is of the kraft or manila type. While voltage tests on miniature samples of insulation are of considerable value along some lines, they are not believed to be a reliable basis for the comparison of compounds. The interdependence of the contraction-temperature and viscosity-temperature characteristics of the compound in their controlling influence on the formation of voids should receive more general consideration. Tentative indications have been found that a decrease in air content of the insula tion might increase the tendency towards ionisation, because of the resulting decrease in void pressure. It is worth recording that it has been suggested that ionisation might be decreased by the presence of moisture, because of the resulting more complete void distribution and consequent smaller size of each void.

French Industrial Conditions.

The shortage of skilled labour in France, which was discussed here last week, continues to be one of the subjects which are engaging attention in the technical industries in France. In obedience to supply and demand, the skilled labour which is available, being insufficient to satisfy everybody, continues to increase in price, and fears are expressed that as labour is one of the more important factors in the cost of a finished article, if its price keeps on advancing as it has done lately it may become impossible for French industrial manufacturers to face competition. Equally difficult will it be to reduce the cost of wages when trade is less brisk. At the present moment, however, employers are practically competing with each other in order to obtain skilled workmen, and one of the inducements often offered is a guarantee that the workman will be provided with living accommodation. This accommodation is generally provided by the firm, and frequently consists of a small portion of a long shed which is divided into "quarters" by thin partitions and may be lengthened as required by the number of workmen to accommodate. Sometimes the building is constructed entirely of wood with felt roofing, and, generally, the conditions are such as would not be tolerated by any local authority in England. The question has been discussed whether it would not be possible for firms to take advantage even of the Loucheur Act, which grants Government assistance—similar to that of a building society—to persons desirous of purchasing their own houses, as it is argued that with financial assistance many firms would be able to build more extensively, but it appears that this Act cannot be applied to employers of labour, and that assistance should be sought by them rather in a reduction of taxes. Other dominating features in present conditions of French technical industries are: an increase of production, diminution of exports, and the higher absorbing power of the home market. In the metallurgical industries, for example, this development of production started about a year ago. During 1928 the output of pig-iron exceeded 19 million tons, which shows an increase of 10 per cent. over 1913, and 6 per cent. over 1926. Nevertheless, the diminution of exports is regarded as of primary importance, because hitherto French production has been much in excess of national requirements, and foreign markets have therefore been essential. However, with the "safeguarding" 33 per cent. in England, the United States developing her exports, Germany extending her foreign commerce in every possible direction, and several new countries starting national industries themselves, it is feared that an increase in French exports of electrical and metallurgical articles will not be obtained for some time, and that in the meantime the development of the French domestic market offers the path of least resistance.

Lifting Magnets in Foundries.

The electric lifting magnet has become so popular for many engineering purposes, and has so much to commend it, that it is surprising that it has not come into more general use in ferrous foundries. For transporting pig iron from the stockyard to the cupola charging platform it has distinct advantages over the crane, and it is also a labour saver in unloading the pig iron when it arrives in railway wagons. For a number of years certain large foundries have made use of the magnet for sorting out chaplets, pieces of core iron, and nails from moulds and cores after castings have been made, and this is probably one of its most labour-saving uses. In every foundry, large and small, the breaking up of waster castings and especially of heavy scrap is a difficult problem, and even otherwise well-equipped foundries still make use of a heavy cast iron ball, sometimes called "a skull cracker," which is released by the time-honoured monkey. The chief objection to the monkey is the danger attendant on its use, because it has to be released by a rope held by a labourer, but by means of an electric magnet the ball can be lifted quickly and safely to the necessary height and dropped on to the scrap iron, or waster casting, when desired. Magnets are now obtainable that will lift up to 80 lb., but for foundry purposes a small-capacity magnet is quite satisfactory. Their operation is so simple, and the fact that the crane driver does not really require an assistant, constitute such a reduction of labour cost that it would appear to be only necessary for foundrymen to be made aware of the advantages attaching to their use for lifting magnets to be more generally employed in foundries, especially those which produce a large tonnage of medium and heavy-weight castings.

A New Trade Association.

The Ultra-Violet and Allied Trades Association has been formed to promote closer co-operation between manufacturers with a view to introducing improvements in apparatus coming within the scope of the title; arranging consultations with the profession on points of mutual consequence; and forming a clearing house for information—technical and constructional—respecting electro-therapy, as well as fostering the development of this branch of medical science. Some further particulars appear in our "Business Notices" to-day concerning the new Association, of which Mr. C. Rodgers is the secretary.

Electricity Supply in Wellington.

An outline of the history and progress of the Electric Lighting Department of the Wellington Corporation, New Zealand.

By M. CABLE, M.I.E.E., General Manager.

IN the year 1888 an agreement was entered into between the Wellington Corporation and a private company to provide 500 20-candle-power street lamps, the electricity to be generated by water turbines supplied from the city's water mains. In 1891 the company sought Parliamentary powers to supply electricity to private consumers, and two years later four 75-kW steam-driven alternators were commissioned; the supply system was at 2,200 volts, 80 cycles, single-phase, with a 105-volt two-wire secondary system, all lines being overhead.

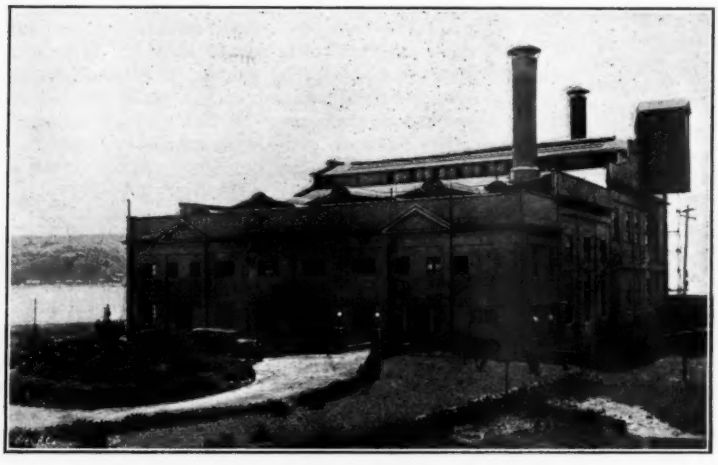


Fig. 1.—Evans Bay Power Station, 10,000 kW.

In 1904 the Corporation inaugurated an electric tramway system and laid down a new steam power station generating at 550 volts, and shortly afterwards provided a supply for private power from an underground reticulation. After prolonged negotiations, the Corporation purchased the business of the private company in 1906 and immediately ordered its first 1,500-kW turbine, which set was duplicated in 1913. During the 1914-18 European War period it was impossible to purchase plant for either power station, and in 1919 both sets of plant were seriously overloaded, and the problem of modernising the two systems was complicated by the fact that the Government had commenced to construct the Mangahao hydro-electric system from which power was to be purchased in bulk at 11,000 volts, three-phase, 50 cycles; but the supply was not available until 1925. In 1922 it was finally decided to construct a new power station at Evans Bay (fig. 1) and a 5,000-kW, three-phase, 11,000-volt turbo-alternator was ordered and placed in commission. Later, a 1,000-kW d.c. geared turbine was removed from the tramway station to Evans Bay and also the two turbines from the old 80-cycle station, to which new 2,000-kW alternators were fitted. This brought the new station up to 10,000-kW rating.

Evans Bay Power Station.—The boiler plant consists of six B. & W. boilers, two coal-fired marine-type boilers of 220 lb. per sq. in. pressure, with 7,000 sq. ft. of heating surface, including economisers, and two coal-fired land-type boilers with 6,182 sq. ft. of heating surface; all grates are of the chain type. Two B. & W. land-type boilers with 7,740 sq. ft. of heating surface and of 160 lb. per sq. in. pressure were removed from the old stations and re-erected and fitted with oil-fuel burners, nine burners to each boiler (fig. 2). The oil is heated to a temperature of from 150 to 170 deg. F. and injected at a pressure of from 60 to 150 lb. per sq. in., depending on load requirements. The oil-fired boilers have proved invaluable in meeting urgent calls for power and also for taking large peak loads over short intervals.

When the whole station is operating under purely stand-by conditions, it is probable that the whole of the boiler plant will be oil fired in order to reduce the operating staff to a minimum and also to save the cost of stand-by fuel.

Oil fuel is stored on site up to 30,000 gallons, and the supply tanks are supplied by a 3-in. pipe-line direct from a large oil company's works half a mile away. Coal having a calorific value of 13,500 B.th.u. per lb. costs 36s. per ton at the station and oil fuel £4 per ton, so that on a heat basis oil is considerably more expensive than coal.

Government Supply.—Bulk supply at 11,000 volts is taken from the Government sub-station at Khandallah (fig. 3), three and a half miles north of the centre of the city. Power is purchased at the Government standard rates of 0-200 kVA, £2 10s. per kVA per quarter; 200-5,000 kVA, £2 per quarter; 5,000 kVA upwards, £1 15s. per quarter, with no "unit" charge. The city pays on a kW, not a kVA basis, provided that the power factor on the peak load is above 0.9 lagging.

Fig. 2.—Oil Burners in Operation on Stand-by Boilers.

The power is metered at Khandallah and recorded by printometers every half hour. The city has to guarantee a minimum of power purchased per annum, on a rising scale for the period of the contract, which is ten years.

Due to very dry seasons during the last two years and also to very rapid increase in load, the Government hydro-station at Mangahao has been unable to supply the whole of the city's requirements, and on numerous occasions the Evans Bay plant has been operating on

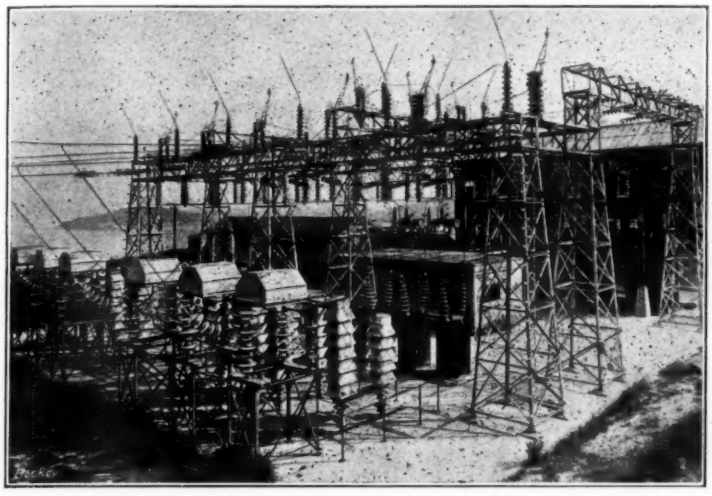


Fig. 3.—Government Sub-station at Khandallah; two 10,000-kVA Banks, 110/11 kV.

continuous full load for two or three weeks at a time. Under these conditions, power is supplied back to the Government in the night hours and during part of the day, if the load permits. Had it not been for the city's steam plant, the electricity supply in the city and surrounding districts would have been severely curtailed for several weeks at a time. Early this year the new hydro station at Waikaremoana will be in commission, and it will relieve the situation, providing that the 110-kV line connecting the city and the Waikaremoana station, 234 miles away, gives reliable service. When the new line is put into commission, voltage control will be effected by means of a 10,000-kVA synchronous condenser at Khandallah. The principal operating troubles have been due to short circuits on the Government 110-kV system putting all the city's synchronous plant out of step and, as the latter includes two 2,000-kW frequency changers with motor-operated moving stators, fig. 5, supplying public lighting on the old system, the interruptions have occasionally been serious. With improved methods of inspection and testing, the interruptions have been greatly minimised.

Distribution System.—The old 2,200-volt, single-phase, 80-cycle system consisted of overhead v.i.r. mains with pole-mounted transformers of from 50 to 2 kVA, with a 105-volt two-wire secondary system. This system supplied all public and private lighting and a small amount of industrial power. The major portion of the power was in the centre of the city and supplied by an underground system from the tramway 550-volt d.c. station. In 1923 lengthy consideration was given to the type of system to be adopted, and it was finally decided to lay down a 400/230-volt, 3-phase, 4-wire, 50-cycle system, the standard adopted in N.Z., and now in England. The d.c. power system has been retained, but new extensions are limited principally to lifts, of which large numbers are in use.

The new 50-cycle primary distribution is at 11,000 volts, practically all underground, with a 3,300-volt system in the lightly-loaded suburban districts, most of which is overhead (see figs. 4 to 8). The layouts of these systems are such that all the 11,000-volt sub-stations are designed for duplicate banks of three-phase transformers, and the following ratings have been standardised: 200, 300, and 400 kVA, with possibly 500 kVA as a future limit. All 400-volt feeders are taken out of the sub-stations underground through oil switches with either 0.3- or 0.15-sq. in. 4-core l.c. and s.t.a. cable, even in areas where the l.p. distribution is all overhead.

The 3,300-volt sub-stations vary from 60 and 100 kVA, pole-type, to buildings designed to take two 200-kVA banks. Only three sizes of transformer are used, *viz.*, 60, 100, and 200 kVA. All the 11,000-volt, as well as the 200 kVA, 3,300-volt, transformers are provided with external tapping switches, while the two small sizes are provided with tapping plugs under the oil.

The 11,000-volt underground cables are all lead covered and steel-tape armoured, laid direct in the ground, and the conductor sections vary from 0.3 to 0.04 sq. in. All 3,300-volt cables have a section of 0.04 sq. in., while the v.i.r. overhead-line sizes are 0.06, 0.04, and 0.025 sq. in. Under Government Regulations all 3,300-volt overhead lines have a minimum ground clearance of 21 feet at maximum temperature. All the 400-volt distribution system is overhead, except in the centre of the city, where it is all underground.

The overhead phase wires are triple braided and weather-proofed, the neutral being bare. The phase-wire sizes are 0.10, 0.06 and 0.04 sq. in. in section, the maximum size being limited by the pole loading at street corners. All poles are Australian ironbark, square hewn. At the intersections between sub-station areas having overhead lines, weatherproof ironclad three-pole knife switches are being mounted on the poles just below the wires, so that in case of failure of supply in one area, or when it is required to cut out a sub-station for overhaul, the area can be supplied from adjacent areas.

The underground 400-volt system consists of 0.3- and 0.15-sq. in., 4-core, l.c. and s.t.a. cables laid direct in

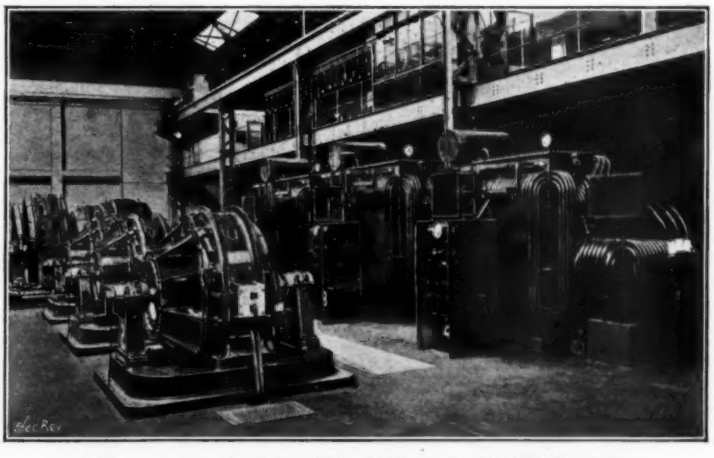


Fig. 4.—Jervois Quay Sub-station; 1,500-kW Rotaries and E.H.P. Control Board.

the ground. In most of the main streets 0.3-sq. in. cables are laid on both sides of the streets. The distribution cables form a continuous network through underground link boxes of the bus-bar type, the system being divided up into small sections, each of which can be fed from more than one direction; most of the link boxes are of the four-way type. All services are made with four-core l.c. and s.t.a. cable, the minimum size being 0.04 sq. in., and for small consumers a multiple service box

is placed in doorways, &c., arranged to take up to five conduit services to adjacent consumers.

Tramway Supply.—The City's Electricity Department supplies power to the tramway system at 550 volts d.c., the Tramway Department providing its own underground distribution system. The traction load is approximately ten million kWh per annum, with a maximum demand of 4,500 kW. Supply is given from three

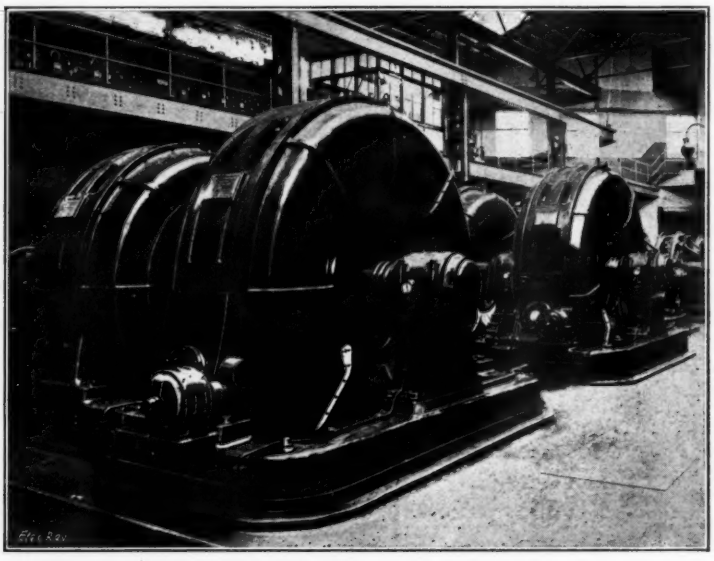


Fig. 5.—Two 2,000-kW Frequency Changers in Jervois Quay Sub-station.

1,500-kW rotary convertors in the centre of the city, three 750-kW automatic rotary convertors in suburban districts, and one 500-kW convertor at the Evans Bay power station. All the automatic stations are controlled by pilot wires for stopping and starting as well as reclosing d.c. traction breakers. In one case, each individual feeder, as well as the machine, is controlled by supervisory equipment which gives independent control "in" or "out" for each switch, as well as a "red" or "green" light to show the switch positions.

Change-Over of A.C. Supply.—A commencement to change over the 80-cycle, 105-volt, single-phase, two-wire system to the 50-cycle, 400/230-volt, three-phase, 4-wire system was made in 1925, and it is anticipated that, apart from a few old buildings in the centre of the city, the change-over will be completed in four years' time. The change-over is being carried out under special regulations issued by the Government, as follows:—

Classification.—The consumers' installations shall be classified as follows:—

Class (*a*)—Installations of which the wiring is found to be in accordance with the licensee's rules and regulations adopted on December 17th, 1908, and only require alterations necessitated by the change of system.

Class (*b*)—Installations of which the wiring is found to be defective under the licensee's rules and regulations adopted on December 17th, 1908.

Class (*c*)—Installations of which the wiring is worn out by effluxion of time, or service, and under any conditions would require to be re-wired within a short period.

Allocation of Cost.—The cost of alterations shall be allocated as follows:—

Class (*a*)—The whole of the cost shall be paid by the licensee, provided always that in the case of extensions and alterations which have not been authorised by the licensee the cost of alterations thereto shall be borne by the consumer.

Class (*b*)—The cost of removing all defects shall be paid by the consumer, and the cost of alterations due to change in system shall be paid by the licensee.

Class (*c*)—The whole cost shall be paid by the consumer.

In cases in which the consumers do not desire to pay in full at the time of the alterations the cost for which they are liable, the whole of such work shall be carried out by the licensee through contractors, or its own servants, and the whole of such cost, or any portion of it, shall, unless the licensee and the consumer shall agree otherwise, be carried out under the provisions of the Municipal Corporations Act, 1920, or any statutory modification thereof as to payment.

Provision may be made for consumers to pay the instalments due with their regular accounts for the supply of electricity.

All work under clauses (*a*) and (*b*) affected by this clause shall, unless otherwise agreed upon between the licensee and the consumer, be carried out by the Corporation.

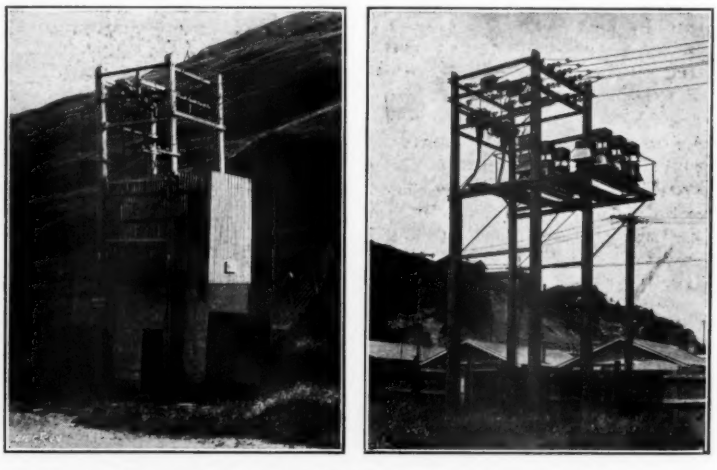
In case of any dispute arising in respect of matters affected by this clause between the licensee and a consumer, a Board of Appeal (whose decision shall be final) shall be set up to decide such dispute; the Board of Appeal shall consist of the following:—

(1) One representative appointed by the licensee.

(2) One representative appointed by the consumer on whose premises the alterations are to be made.

(3) The senior stipendiary magistrate for the City of Wellington (who shall be chairman).

In the suburban districts the new distribution system has been superimposed on the old system, and the whole area changed over in the course of a few months, but in the city area where there are many old buildings that are being gradually pulled down, and where there are many expensive installations that require completely rewiring for the new voltage, the new system of supply is at present only being used for new buildings, or where a consumer requires any extensions to an existing supply from the old system, such extension is only made on the new system when the whole of the installation is changed over. In the domestic area the change-over has resulted in a large increase in the number of lighting and heating points installed. In order to supply the old system two 2,000-kW frequency changers were installed in 1924,



Figs. 6 and 7.—Terminal Towers, 11,000 V, with Indoor and Outdoor Arrestors.

as the main supply to the system then became 11,000 volts, three-phase, 50 cycles.

Tariffs.—The following is a summary of the net tariffs at present in force:—

Commercial lighting: 6d. per kWh for the first 200 kWh per month, with a sliding scale down to 3d. per kWh for all over 1,000 kWh per month.

Commercial heating and radiators: 2d. per kWh.

Power: 2¾d. per kWh for the first 300 kWh per month,

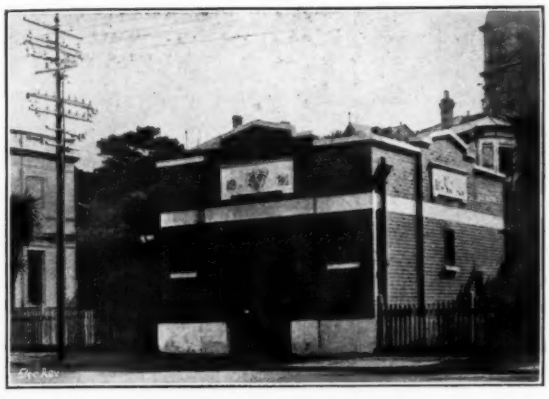


Fig. 8.—Typical Transformer Sub-station, 11,000/400 Volts. Two Banks.

with a sliding scale down to 1¼d. per kWh for all over 2,000 kWh per month.

Alternatively: 25s. per kVA of maximum demand per quarter up to 50 kVA, and 20s. per kVA over 50 kVA, plus ½d. per kWh. The maximum demand is taken over 30 minutes.

Domestic supply: with one meter, 5d. per kWh per month for the first 2 kWh per living room, minus one room, with the balance at 1½d. per kWh for ordinary consumers and at 1d. per kWh for cooking consumers. Energy for water heating is supplied at 9d. per 100 watts per month, fixed charge, for a nine-hour night supply with a time switch.

Size of System.—The system's maximum demand to date is 13,700 kW, with a monthly load factor of 42 per cent. in midwinter and 50 per cent. in midsummer. Electric lighting is universally used for residences and shops, and in commercial offices there is a winter load of from 2,000 to 3,000 kW due to office radiators. The industrial load consists of approximately 20,000 h.p. of motors.

The domestic supply for electric cooking and water heating is rapidly growing, due to recent reductions of the tariff. When the change-over is nearly completed it is anticipated that further reductions of the tariff will bring a rapid increase in the load and plans are being considered for extensions for a ten per cent. increase per annum over the next ten years.

Government Regulations.—Authority to generate, distribute, and sell electricity is given to the Corporation by Government licence and all works must be erected and operated to the Government Electrical Regulations, 1927, which are in force throughout the country. The Regulations also apply to the construction and operating conditions where the Post and Telegraph and Railway Departments are concerned. The electrical installation of consumers' premises is also governed by Government Regulations, 1927. They require a high standard of material and workmanship and are based on the best British practice.

All installation work is carried out by wiremen who have passed theoretical and practical examinations under Government regulation, and who receive the necessary licence which permits the holder to work anywhere in the country. In the event of any serious defects being found on an installation, the wireman's licence is liable to be cancelled.

The Lighting of St. Martin's.

Some Particulars of the Remodelled Installation.

WHILE the fame of most well-known churches depends on their antiquity, that of St. Martin's-in-the-Fields, London, is due mainly to its modernity—the fact that it is the "parish church of broadcasting."

The present building is only about 200 years old and it is of the classic style favoured in the early 18th century. The interior, from the illumination point of view, does not present so many difficulties as the usual style of church in which the nave is of great height. In St. Martin's there is a ceiling, richly decorated with cerulian and gold panels, which permits of a very definite lighting scheme.

As will be seen from fig. 1 the lighting of the nave is accomplished by means of a series of enclosed units, which, being suspended mid-way between the ceiling and floor, provide adequate all-round illumination. The fittings were entirely remodelled by the General Electric Co., Ltd., having been in use in the earlier installation. In the course of the conversion special glass was employed, and the wiring was improved. Each is now provided with a highly-concentrated "Gecoray" reflector; the base of the fitting is of diffusing glass of low absorption, and the side panels are of flashed opal glass. They are also equipped with three 40-W lamps for auxiliary lighting, on separate circuits, to slightly increase the illumination on the ceiling and to enable the intensity of illumination to be evenly re

Fig. 1.—The Lighting of the Nave.

duced as required. One of the nave units is illustrated in fig. 2; from this it will be seen that the design is in harmony with the architecture of the church and, in

fact, rather closer to the classic style to which the building was evidently intended by its architect to conform.

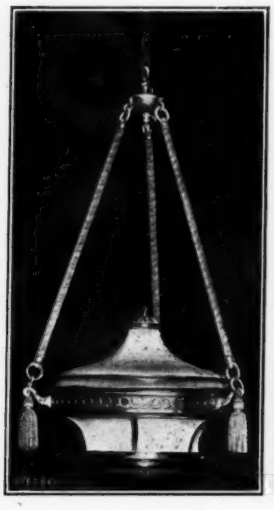


Fig. 2.—One of the Nave Units.

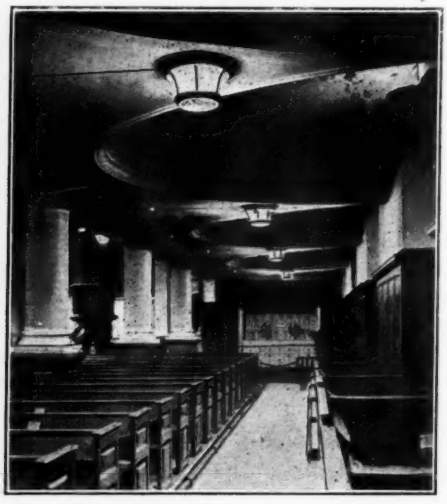


Fig. 3.—Illumination under the Gallery.

The gallery units are on very similar lines, though without the auxiliary lighting, and these, too, have been re-modelled. Under the gallery there are fittings of the same pattern adapted for ceiling fixing. These are equipped with a shallow white vitreous-enamelled top reflector, giving a wide angle of reflection, the base and sides being glazed to match the nave and gallery units. The even distribution obtained in this way on the pews and walls is apparent from fig. 3.

The lighting of the altar and chancel by floodlights and reflectors has not been revised, while the royal boxes, one of which can be seen behind the pulpit in fig. 1, are suitably illuminated. It is stated that although the new system gives a much greater intensity, owing to the improved distribution, the consumption of energy is actually lower than before. At pew level the illumination is sufficient to enable the smallest print to be read with ease, in spite of the fact that the whole of the seating accommodation is of dark woodwork with very poor reflective qualities.

The installation was designed by the G.E.C. Illuminating Engineering Department, which prepared the scheme in accordance with the wishes of the church authorities, and the work was carried out by Messrs. Maxwell, Butcher & Co., Ltd.

The Fundamentals of Electrical Merchandising.

The author, who has had some years of experience in the work with which he deals, with a large American public utility company, sets out the necessity for encouraging the fullest use of electricity by existing consumers and suggests means by which this can be realised.

By S. M. KENNEDY (California).

IT is an undisputed fact that this world in which we live has never known of an industry whose growth and development has been as full of romantic history as that of electricity. The romance must continue as time goes by, for the wonderful usefulness of this mysterious energy now seems to have no limitations.

The progress of the electric power business has been marked by very pronounced periods of development In the earlier stages of the history of the electrical business, lighting by electricity seemed to be the only object, and it must now be acknowledged that for many years electric lighting was crude and expensive, but even in that condition was better than any other means of illumination in these pioneer days. Several years elapsed before electric power service was used for industrial and domestic purposes, this time being occupied in educating the people to establish the necessary confidence in order to bring about the more general use of electricity for other purposes than illumination. All the development work in steam and water power generating plants, transmission lines, sub-stations, and distribution systems gradually pointed to the necessity of supplying more service, and at the present time, the paramount idea of all operators in the electrical business is what is now termed "load building." Load building reaches out in many directions, and one of the most important phases to-day is that of electrical merchandising. It is not necessary here to enumerate the many and various kinds of current-consuming devices which are now available, but rather to consider the reasons for a far-reaching system of disposing of these appliances so that load building may be carried on consistently and continuously.

What may be considered the different angles of approach to this very important work have been outlined in a verse by Rudyard Kipling:

> "I keep six honest serving men,
> (They taught me all I knew),
> Their names are WHAT and WHY and WHEN
> And HOW and WHERE and WHO."

The idea of electrical merchandising may well be considered from these six standpoints—the first one being WHAT does this kind of load building mean to the power companies? It is the creation of a demand for electrical energy and the supplying of a great need in the territory served. The creation of a demand means the education of the company's customers so that they will feel the necessity of purchasing certain useful, convenient, and time-saving apparatus, this apparatus to be operated by electrical energy. In all directions there is a real need for such service. The trouble is that many consumers do not know what they need until it is clearly and carefully pointed out to them that they will be better off than they were before with comparatively little, if any, increased expense. In fact, in many instances where electricity is used in place of other means to do certain work, there is a distinct saving of money. Now it so happens that there are numerous classes of merchants who are anxious and willing to sell electrical merchandise. Their object, however, is to make a profit on each

piece of merchandise that is sold and their interest ends when the sale is consummated. The power company has an entirely different object and the profit on the sale of electrical merchandise, while important, is not the reason why the power company is doing this kind of work. The real object is load building. It is in the interest of the power company to encourage all classes of merchants to sell electrical equipment to their customers, and in addition for the power company to do missionary work and to stimulate such sales by merchants as well as through salesmen. For this reason there should be a maintenance of standard prices so that there will be complete harmony between the merchants and power company, and the merchants will be enabled to get a reasonable profit and the power company a proper return on the merchandise which it sells in order to meet the expense of salesmen's salaries and commissions, the maintenance of showrooms and necessary advertising, and promotion work. Price-cutting is demoralising and entirely unnecessary. If the demand for the merchandise is created, the question of price is of minor importance.

The second phase of this great subject is WHY should electrical merchandising be carried on by the power company? It has been pointed out that the primary object of these sales is load building. Load building naturally increases load factor, and this automatically reduces the operating expenses which eventually means a lower cost per kilopatt-hour. A lower cost per kilowatt-hour points to a lower rate for service to the customer and the lower rate inevitably means increased consumption and greater revenue. Now then, if you obtain a greater revenue with a decrease in the unit cost for energy, you have undoubtedly added stability to the power company's business. Further, the more appliances which the company's customers have in use in their homes the more the power company becomes necessary to the customer because of the greater service. If this greater service is supplied under conditions which abound with courtesy, consideration and efficiency, then the standing of the power company in the community in which it operates becomes ideal. The company's customers under such conditions are easily induced to become stock-holders and partners, and a great bulwark is eventually built up to protect the company's property and forward its best interests.

The third division of this subject is WHEN should electrical merchandising be carried on? There is no limit as to time, and it will be found that after a customer has been using one or more electrical appliances in his home or place of business, he becomes open minded and is usually ready to listen to what a salesman has to say regarding other and perhaps newer devices which are available for his use. There never has been, and probably never will be, such a thing as saturation among any class of consumers in a power company's business On the other hand, in a well-organised and well-operated power company business, there should be a constantly increasing consumption of electrical energy among all classes of consumers. After a customer has been convinced that he needs, or would be better off with, any particular kind of electrical appliance, it may be discovered that he has not the cash to make the purchase. In such circumstances it is to the advantage of the power company to assist the customer in purchasing this apparatus. If the power company has to wait for the time when the customer has the cash, there is a postponement of additional load which should be acquired at once if handled properly. This, of course, means that the company should arrange a deferred-payment plan. The available records indicate that sales of this kind are usually satisfactory and that repossessions by the power company of appliances sold under such conditions are comparatively rare. Salesmen soliciting business for electrical merchandise should always be carefully trained before they are turned into the field. This is important and will save much time in obtaining proper results from their work, and time is money.

The next question is HOW? The answer is easy—it is by spending money, but the money must be wisely spent. A power company's customer will not usually walk into the company's office and say, "Send me this appliance or that device," and then go home and await its arrival. Instead, a demand must be created by some accepted and proven means. Advertising in daily papers and periodicals is a sound method, but the advertisements must be carefully written and displayed by those who have had experience in the work. The first function of advertising is to get merchandising messages read; the second is to make sales. In order to obtain the attention of the reader—to arrest the eye and arouse interest—advertising must be attractive in its physical presentation, that means lay-outs, illustrations and typography. Satisfactory results must surely follow.

Then there is the display in windows and showrooms which tells the story silently, but often effectively. Next are demonstrations in public rooms and private houses which show the actual application and use of appliances. Last, there are the salesmen and saleswomen, who call on customers in their homes and places of business; who go about their work thoughtfully and tactfully. These emissaries arouse interest, create a demand and make sales day by day, and pile up lists of prospects for attention later on. Such representatives of the power company should regularly "check themselves up" to see if they look, speak and act the part and do the company justice. They should realise that each one is an individual with a mission and not simply a cog in a wheel. If they understand this they will accomplish much more and their work will become many times more interesting.

The fifth point to be considered is WHERE should electrical merchandising be carried on? The answer to this question is: Wherever the company's lines extend and the service is being supplied, the business of electrical merchandising should be pushed to the limit. Further, with the constantly increasing number of current-consuming devices for new uses, opportunities develop for making profitable extensions to distribution systems in order to supply new territorities and additional customers, especially in rural and interurban districts. Take, for instance, the subject of electric cooking and refrigeration. In many suburban districts, gas has not been available and ice has been difficult to obtain when it was most wanted. With the modern equipment of electric ranges and electric refrigerators, this class of service is recognised as a blessing, and in addition to the convenience and satisfaction of such service, there is a real saving to the consumer in dollars and cents in his monthly expenses. The cost of electrical energy for cooking and refrigeration when properly used is much less than the cost of fuel for ordinary ranges and for ice purchased and delivered in rural districts. All that is needed to make sales is education by means of personal solicitation and carefully prepared advertising matter distributed where it will do the most good, and create interest and demand.

The final query is WHO shall do this electrical merchandising which is such an important branch of load building? It may be assumed that every progressive power company has a regular sales organisation which works continuously and efficiently. It may be further assumed that all merchants, such as electrical dealers, department stores, furniture stores, drug stores and hardware stores are encouraged to make as many sales of electrical appliances as they possibly can. But what about all other employés connected with the power company? Think of their opportunities to say a favourable word or two regarding this or that appliance! Think of the questions that are asked concerning the price or cost of operation of certain devices that consumers may have heard of from neighbours and friends! Think of the curiosity and interest that may be aroused in some consumers by the leaving or mailing of a timely folder! Clerks, collectors, meter readers and trouble men have an endless number of contacts with customers which should be capitalised without taking up much of

their time. So have all other company employés—among their friends and neighbours. But, some will say, such employés are not salesmen. Quite true—but they have sufficient knowledge to fill in prospect cards and send them in to the sales manager. Innumerable sales may be made in this way. Employés sending in prospect cards should be encouraged by means of a cash commission whenever a sale is made through their interest and effort. In short—"WHO" is every one connected with the power company that has the growth and prosperity of the company at heart.

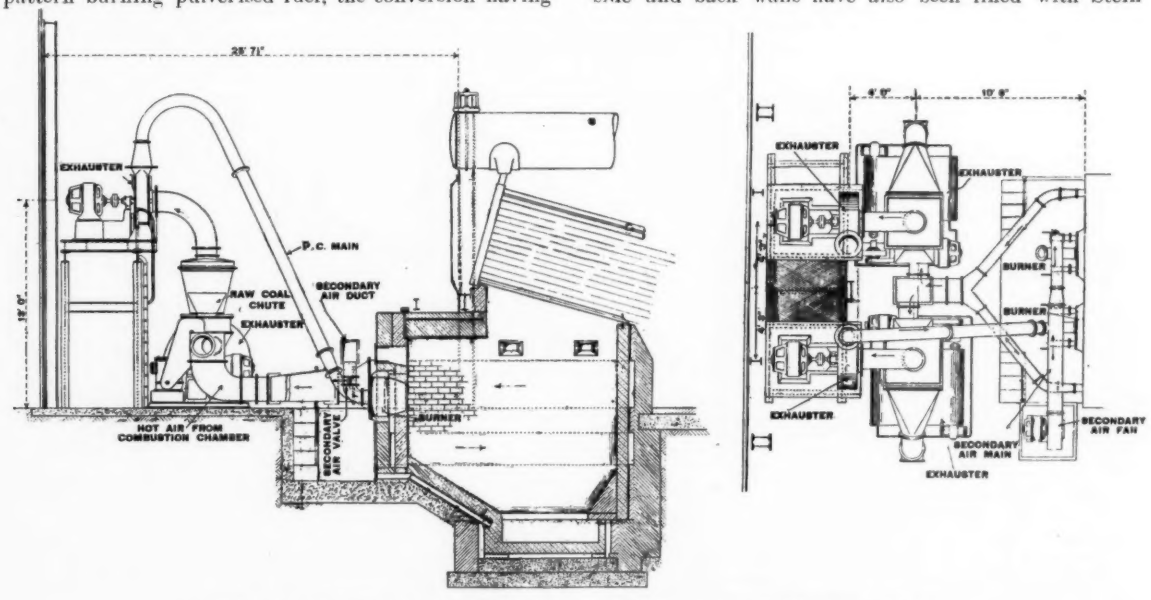
After all, the entire work of a power company's organisation leads up to the meter. Find a department that is not functioning in the ultimate direction of the meter, and you will find a department that may be closed down. Discover an officer or employé whose work does not eventually point toward the meter and you will discover a man whose services may be dispensed with. Think, then, how desirable it is to load up the meter and the lines leading up to it, so that a greater revenue may be obtained from present investment. That's what electrical merchandising means! But, it cannot be done in a haphazard fashion to get the desired results. The plan of operation must be scientifically worked out. Estimates should be prepared regarding the average number of appliances which should be absorbed yearly for each thousand consumers. Quotas should be figured as to the number of merchandise sales expected from each district in proportion to the number of consumers served. Quotas should also be estimated as to the horse-power added by the merchandise sales—because one district may sell fewer electrical appliances but representing a much greater amount of horse-power than another district with heavier individual merchandise sales. A friendly emulation should be stimulated between the various districts, and prizes might be offered to those districts that show the greatest excess over quotas—both as to number of sales and horse-power added.

It is beyond a shadow of doubt that electricity has done more than anything else to make life easier and more agreeable than it ever was before in the history of the world. It has been the great time saver; it has lightened labour; it has added conveniences never before dreamed of; it has brought entertainment and pleasure to our doors and in our homes; and has connected the ends of the earth together so that we are familiar with what is going on in far-away places. It is a pleasure and honour to be connected with the great industry that has done so much for the world and a joy to know we are doing our share. The man who invents a great generating machine deserves full credit for his accomplishment. The man who is the means of putting a modern electrical appliance into a home also deserves credit for what he has done, and he has a right to be proud of his work. Electrical merchandising is a big job, and needs big men. The best test of all work is results, and electrical mechandising points to far-reaching and highly satisfactory results in very many directions.

A Pulverised-fuel Boiler.

A description of the conversion of a water-tube boiler to burn powdered coal at the Stretford Urban District Council's electricity works.

A RECENT visit to the electricity generating station of the Stretford Urban District Council at Trafford Park, Manchester, afforded an opportunity of seeing a water-tube boiler of the ordinary pattern burning pulverised fuel, the conversion having been successfully effected with a minimum of alteration and at small cost.



Figs. 1 and 2.—Pulverised-fuel-firing Arrangements; Section and Plan.

The boiler is of the Babcock and Wilcox land type, working at 175 lb. per square inch and rated at an evaporation of 25,000 lb. of water per hour, with chain grate stokers; the grate has been removed, and the ash-pit lowered a little, and in front of the boiler there has been built an annexe of the Dutch-oven type, occupying the space formerly covered by the chain grate. The side and back walls have also been lined with Stein bricks (Thistle brand), with air channels, the heated air being led to the mills; but the internal surface of the combustion chamber consists entirely of unshielded brick. A Liptak suspended arch extends across the whole width of the furnace. Some trouble was

experienced with the floor, which is below the standing water level, so that seepage of water and its conversion into steam disturbed the brick floor; this local trouble was overcome by relaying the floor with large tiles on cast-iron blocks, providing an air space between them and the soil, which effectually prevents access of moisture and has solved the problem satisfactorily. Ash falling to the floor is raked out through a side aperture.

The burners, two in number, are of the Buell type, mounted horizontally in the front wall of the boiler. The floor space occupied by the boiler is unchanged.

From the existing overhead bunker the coal (dry slack) is fed through a magnetic separator to an automatic feeder, whence it passes into the mill. Then the powdered fuel is drawn by an exhauster fan through the classifier into a pipe leading to the burner. Hot air, as previously mentioned, from the hollow walls of the combustion chamber, at a temperature of 250 deg. F., is led into the mill, where it dries the fuel, and passes with it into the burner; auxiliary air is fed in outside the burner, and dampers are provided below, but are not used. A secondary air fan is also provided for extra air admission. The air pressure at the inlet of the burner is 2 inches of water, and the draught at the outlet of the boiler about $\frac{3}{8}$ inch.

The mill is of the Fuller-Bonnot type, with a serrated liner half filled with small balls, revolving at 37 r.p.m., and driven by a motor rated at 30 h.p. The construction of the mill is such that coal which has not been reduced to a sufficiently small size automatically returns to the inlet and again passes through the mill. The exhauster fan requires 4-5 h.p. A complete set of pulverising plant is provided for each burner.

The injected air and fuel enter the combustion chamber horizontally, and the flame starts close to the nozzle of the burner; the character of the flame can be controlled by a hollow cone valve.

With this arrangement the boiler has been worked at an evaporation of 33,000 lb. per hour, and a CO_2 content of from 10 to 15 per cent., depending somewhat on the class of coal in use. This simple plant has been at work for two years, with the exception of the mills, which were changed a few months ago. The normal consumption of fuel is about 1.3 tons per hour; the burner can be lighted up in about five minutes, and full steam pressure is attained in $1\frac{1}{4}$ hours with one burner at work. Both burners can, of course, be used to raise steam more quickly. Starting up at 5 a.m. on Monday morning, the boiler usually runs through till Friday night without going off load, and has run for two weeks continuously with every satisfaction.

Coal brought to the works in barges on the canal is carried into the bunkers by suction plant, which has been operated at the rate of 300 tons per day. The same plant can draw the coal from a store on the further side of the canal, or from a wagon tippler. The coal pipe is 6 inches in diameter, and the exhauster is driven by a 50-kW motor.

The burners used on this boiler are of the Buell patent dispersive type, giving a short flame with low velocity; as shown in the cross-section, fig 1, the stream of powdered fuel is opened out by passing over a hollow cone, through which flows a stream of air; the cone can be moved in or out by means of a hand-wheel, to regulate the length and diameter of the flame. The particles of fuel, passing through the conical rings, strike the inside of the conical outer housing and are deflected inwards, mixing thoroughly with the curents of air admitted through the centre pipe, through the air ports round the fuel pipe, in the face of the inner housing, and through the ports between the inner and outer housings. Curtains of air from the secondary air fan are also admitted through pipes inside the outer housing. It is claimed that intimate mixture of fuel and air is obtained: the flame is short and white-hot, yet the burner is kept cool by the air-jets which play upon it: and the flame is under efficient control by means of the hand-wheel.

Soon after the pulverised-fuel plant had been installed an efficiency test was carried out, with coal having a gross calorific value (dry) of 13,270 B.th.u. per lb. The rate of evaporation was 25,633 lb. per hour, and the CO_2 in the flue gases was over 11 per cent. The actual evaporation per lb. of fuel was 8.26 lb. of water, and the fuel consumption per hour per cubic foot of furnace volume was 1.7 lb., generating 20,600 B.th.u. The efficiency of the boiler, based on gross calorific value, was found to be 83.9 per cent., corresponding to an efficiency of about 88 per cent. based on the net value of the fuel.

Although not a large undertaking, the Stretford power station, which contains in addition to reciprocating plant, turbo-generators of 15,250-kW capacity, is run at a high all-round efficiency. The output for the year 1927-8 was 42,025,223 kWh generated, and (with bulk supply) 54,341,792 kWh sold. The maximum total demand was 18,040 kW, and the annual load factor (sold) 34.4 per cent. The average consumption of coal was 2.4 lb. per kWh generated, and the average price obtained per unit was 0.91d. No new generating plant has been installed since March, 1921.

We are indebted to the engineer to the Council, Mr. T. A. Kerr, M.I.E.E., for the opportunity of obtaining particulars of this interesting example of adaptation of a water-tube boiler of standard construction to pulverised-fuel operation.

Lanoline Rust Preventers.

In Special Report No. 12, "Lanoline Rust Preventers," of the Department of Scientific and Industrial Research (Engineering Research) (H.M. Stationery Office, price 1s. net) are described investigations which have been carried out at the National Physical Laboratory, Teddington, under the supervision of the Engineering Co-ordinating Research Board of the Department of Scientific and Industrial Research, following an inquiry by a Government Department for the best material for the preservation of the bright steel parts of stored machinery. In a preliminary investigation a number of representative preservatives, greases, varnishes and bitumen were used, and tests were made on flat plates and cylindrical bars coated with the materials under test by exposing them to the weather, or immersing them in fresh water, sea water, and aerated hot water. In all the tests the hardening varnishes of all kinds cracked after a short exposure and corrosion occurred at the bottom of the cracks, although the intermediate portions of the test pieces remained quite bright. In some cases the cracks were not visible on the surface until after some weeks of exposure, but the depth of corrosion found on the metal indicated that the cracks had been present long before they were visible to the eye. The coatings of grease showed no sign of the formation of cracks in this manner, and such corrosion as occurred consisted of isolated spots or of discoloured patches. The coatings of lanoline grease, applied as grease or deposited from solutions, appeared to be generally superior to those of petroleum grease, and various trials of a crude lanoline grease showed very great adhesion of the grease film to metal. White spirit and solvent naphtha are inexpensive and satisfactory solvents for lanoline preservatives. Lanoline is capable of absorbing a very small quantity of moisture, and for this reason can be applied to metal without previous preparation for removing a trace of moisture, as should be done when applying petroleum grease. Lanoline may be used as a grease applied by means of a rag and should be well rubbed on the surface of the metal. If the lanoline is mixed with about 10 to 15 per cent. of white spirit it adheres to the metal more readily and a thinner coat may be obtained. Croda, Ltd., Rawcliffe Bridge, Goole, Yorks., will send copies of the Report free to interested firms.

The Printing Exhibition.

Electrical Features of the Exhibits at the Eighth (1929) Show.

THE eighth International Printing and Allied Trades Exhibition was opened at Olympia on April 11th and is to continue to April 25th. As a whole the exhibition emphasises two main points: first, that the electrical equipping of printing plant is the work of the specialist—the amount of electrical equipment about the show is very large and the number of electrical firms represented is very small; secondly, electric driving in the printing industry has won the day practically entirely—it is believed that electric driving is adopted in the case of every working exhibit. Electrical control is becoming more and more necessary in printing machinery. Automatic control is almost general, and speed setting also has become very common; a regulator is set to the required speed to suit the forme and the paper, and thereafter each time the motor is started it will run to the set speed. For rotary presses it is necessary to make provision for speed control from the press itself. In the case of small rotary presses the control panel may be of the solenoid type, but with the addition of a solenoid-operated regulator, instead of the hand-operated regulator provided for a flat-bed press. Larger rotary presses of the two- and three-motor type, and requiring a full range of speed regulation, are controlled by panels of a somewhat similar design, but embodying an auxiliary pilot motor for remote speed control. Auxiliary machinery, such as guillotines, envelope machines, and litho-plate graining machines, which does not require starting and stopping so frequently, is usually controlled by a small panel of the faceplate type.

Among the exhibitors whose attention is directly given to the electrical equipment are Messrs. J. H. Holmes & Co., Ltd., who are showing a model of the Holmes-Clatworthy newspaper press-driving equipment, and also a complete fully automatic controller for operating the actual set. The latter consists of two motors mounted at right angles on a common bedplate. The small motor is used for starting, inching and creeping, and the large motor takes up the load. An example of a new line of motors developed by this firm is being shown. The main feature of these machines is that they employ a standard frame which can be modified so as to convert the motor into the following types: totally enclosed; enclosed ventilated; open protected; pipe ventilated and drip proof. Another interesting machine which is being displayed by Messrs. Holmes is the totally-enclosed, external-fan motor. This type of totally-enclosed motor has been developed to provide machines for duty in situations requiring complete enclosure of the windings and working parts, but at a price very much below that of totally-enclosed motors of the conventional type. The sectional drawing, fig. 1, shows the principle. The motor proper is completely enclosed by the inner casing, which is, it is claimed, dust and weather-proof. The motor frame incorporates an outer casing, and is designed to provide an annular space between the outer and inner casings of the motor; a fan mounted on the spindle blows air through this space between the two outer covers, and over the outside periphery of the stator core plates. The machines have been built to run with

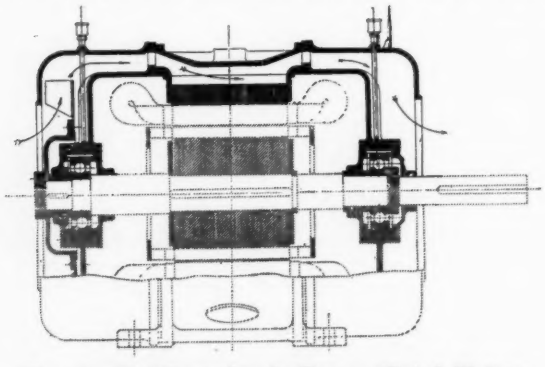


Fig. 1.—Totally-enclosed, Fan-ventilated Motor; Section.

a minimum of attention, and to work in places where there is a damp or dusty atmosphere. The outer end shields are of robust design to withstand rough usage, and are easily detachable for cleaning purposes. Ball or roller bearings are used throughout.

The British Thomson-Houston Co., Ltd., is displaying a number of illustrations and models of electric motors and control equipment for driving rotary and flat-bed printing presses, paper-making machines, auxiliary plant and machinery in printing works and paper mills. The motors are of both the a.c. and d.c. types, for constant and variable speeds on three-phase and direct-current systems, specially designed to meet the varied requirements of the different classes of machinery.

A feature of the B.T.H. variable-speed a.c. commutator motor is its use for driving rotary presses, super-calenders, reelers and paper-making machines, particularly wide fast-running machines making newsprint, as it gives an efficient, steady and easily-controlled variable-speed drive with a.c. supply. The speed range is 3 or 4 to 1; any speed within this range is obtained direct by turning a handwheel, or electrically by push-buttons located in convenient positions. The power taken is

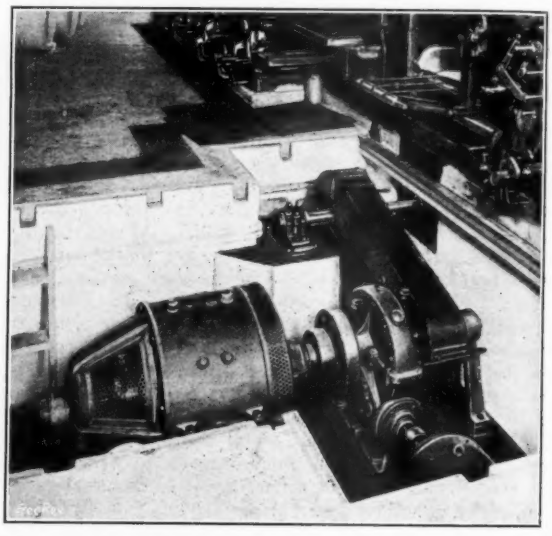


Fig. 2.—Press-driving Equipment; 50-h.p. Driving and 7½-h.p. Barring Motors.

roughly proportional to the speed. Inching and creeping speeds are obtained direct or through the medium of a barring motor according to requirements. The complete driving equipment for a super-calender or reeler consists of a variable-speed a.c. commutator motor for normal operating speeds, an induction motor with worm gear and over-running clutch for driving at feeding-in speeds, and control gear giving simultaneous control of both motors. The advantages include low and very steady feeding-in speeds, acceleration without jerk or shock to the highest operating speed, and economical running at all speeds. These features make B.T.-H. variable-speed a.c. commutator motors specially suitable for driving rotary presses and paper-making machines, using either single-motor drive or sectional drive on the company's patented system, as wastage of paper is cut down to a minimum and increased output obtained in the former case, while increased output of the highest quality paper is obtained in the latter.

Fig. 2 shows the driving equipment at a newspaper office at Burnley. The press is driven by a B.T.-H. 50-h.p. variable-speed d.c. motor, with a 7½-h.p. barring motor with speed-reducing gear. Fig. 3 shows a 4-deck Foster press installed in a newspaper office at Ashton-under-Lyne. The B.T.-H. power unit consists of a 55/18½-h.p., 870/290-r.p.m., a.c., variable-speed commutator motor and a 5-h.p. barring motor with speed-reducing gear. Full-automatic push-button control is fitted.

Messrs. F. Canning & Co., Ltd., have a representative display of plant and apparatus for the deposition of metals as applied to the printing and allied trades, including a new model equipment for the production of electro-deposited copper cylinders. Compared with an exhibit for the same purpose shown at the last Exhibition, the present model is extremely simple and efficient in operation. Also on this stand may be seen a standard electro-typing vat for the production of copper electros, this being an apparatus largely used with which many manufacturers are already familiar. In addition, Messrs. Canning are showing a standard nickel facing vat for the production of nickel-faced stereos. The same apparatus can, of course, be used for the production of nickel electros from lead moulds. It is claimed that the plating increases the life of the stereo by ten times. A large 5,000-A six-volt generator is displayed on this stand, and a standard type of motor-generator is also shown to illustrate the compactness of self-contained electric drives which permit of the electro-typing department being run when other parts of the factory are closed down. Various kinds of brushes for the process block making are shown, together with a range of chemicals and materials specially adapted for the printing trade.

Electromotors, Ltd., are showing both direct- and alternating-current printing-press motors, with control gear for hand or automatic push-button operation, with pre-set speed determination. It is interesting to note that Electromotors have some 50 or 60 motors driving printing machines on various manufacturers' stands.

S.D. Syndicate, Ltd., has an interesting display of British copper for the process trade, as manufactured by British Insulated Cables, Ltd.

P.I.V. Chain Gears, Ltd., have displayed a comprehensive range of their equipments, demonstrating various applications.

Several electrically-heated type- and metal-melting furnaces are to be seen scattered about the Exhibition, including interesting examples of electro-Funditor heaters on the stands of Fry's Metal Foundries, Ltd., and Funditor, Ltd. The electro Funditor is made in models for every kind of composing and casting machine, for linotype, intertype, and so on, and is equally suitable for either a.c. or d.c. The regulating box automatically controls the heat precisely, maintaining the temperature at the mouthpiece, it is claimed, absolutely constant. There is adjustment for five different temperatures. The Funditor is mounted inside the existing metal pot, and a neat switch-box is mounted on the composing machine itself. The elements are claimed to have an unusually long life.

A.S.E.A. Electric, Ltd., has a very interesting display designed primarily to stress the advantages of the 3-phase a.c. variable-speed commutator motor for use in the printing trades. A 4 to 1 speed variation is obtained by movement of the brushes over the commutator, and the power output is approximately proportional to the speed. The efficiency, it is claimed, is not impaired and the p.f. is high. There are, of course, no resistances used in the control of the motor. On the stand is a 5-h.p. motor driving a Miehle 4-roller press, showing the push-button control and the regulation of the brushes remotely from one point. There is also on this stand a complete web-press driving equipment of the two-motor type. The inching and creeping motor is of 26-h.p., and drives through worm gearing and an over-running clutch to the main driving shaft. The main motor is of the 3-phase variable-speed commutator type of 125 h.p. The speed variation is 4-1 and the maximum speed is 750 r.p.m. Remote push-button control is provided. The control panel is of interest; it is specially constructed on the steel-and-mica principle and runs on wheels.

Fig. 3.—Drive for 4-deck Foster Press; 55/18½-h.p. Driving and 5-h.p. Barring Motors.

An example of the "Century" 3-phase commutator motor is on show. This has two entirely separate windings and in the same rotor. The machine has, it is claimed, slip-ring starting characteristics and s.c. running characteristics.

The outstanding feature of the exhibits by Meech Electric Drives, Ltd., is the M.E.D. variable spur gear which is designed to overcome the inherent disadvantages of the existing methods of speed variation in consequence of a.c. supply, and it is claimed that, used in conjunction with a standard high-efficiency a.c. constant-speed motor, the apparatus will give the same flexibility as is at present obtainable with the variable-speed d.c. motor. Practically any desired speed ratio can be arranged, and a true positive drive is produced at all speeds. The gear is of cone formation, and comprises a number of gears of different diameters set up on a countershaft, in close proximity to each other, and married together by dogs. The whole train of gears has the appearance of a solid mass, but in operation each gear has an entirely independent action of its own, and has free movement until it takes up its load, when it is immediately held solid by the dogs of the gears on both sides of it. On the main shaft is mounted a

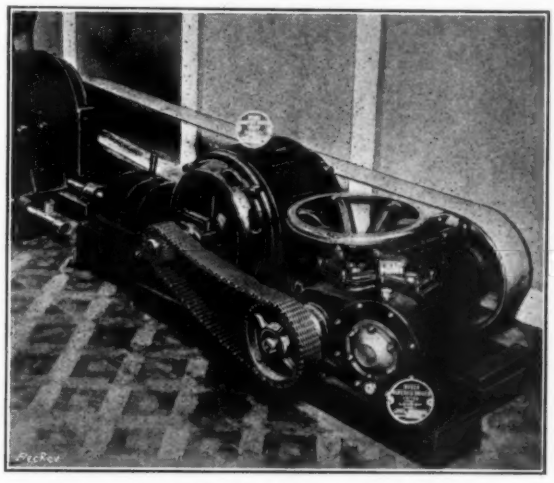


Fig. 4.—M.E.D. Variable-speed Equipment.

driving pinion, mounted on balls. This pinion is so constructed that it can slightly deflect from the perpendicular of the side of the frustrum of the cone wheels while driving, and make perfect line contact along the whole frustrum of the cone, or train of gears of uniform varying diameters. Normally, speed changes are made while the machine is in motion by turning a hand-wheel fitted to the gear box. When more convenient, a small push-button station with "raise" and "lower" buttons can be mounted on the machine. In that case the attendant merely presses one of the buttons until the desired speed is reached, and a device can be incorporated to automatically return the gear to the low-speed position each time the motor is stopped. The following claims are made for the M.E.D. equipment: provides any required number of speeds, neutral and reverse; simplicity in operation; silent and instantaneous; no chains and friction; few parts; freedom from clashing and shocks; robust construction; high efficiency; foolproof. Fig. 4 shows a M.E.D. variable-speed gear working in conjunction with a standard squirrel-cage motor. On this stand are also shown examples of the makers' low-speed electrical power units and d.c. and a.c. motors, wound rotors fitted with slip rings, s.c. and special high-torque rotors.

Messrs. Witton-James, Ltd., are exhibiting a representative line of electric power plant and switch control apparatus for use on a.c. or d.c. services for the newspaper office and jobbing press plant. The company has on view a 40-h.p. d.c. two-motor-type standard variable-speed web press driving equipment, with full automatic push-button control, incorporating a number of recent developments of considerable interest, the combination interlocked with: one magazine reel stand and control gear-operating motors and selector switches; a 60-h.p. variable-speed a.c. web press driving plant with a commutator-type main motor and a fully-automatic control system; a d.c. matrix mangle driving equipment with automatic control; a 3-h.p. d.c. reel hoist outfit with automatic control, underwind and overwind geared limit switch; a single-cylinder unit brake with automatic control system; and a web-break automatic cut-off and stop-press device.

The exhibit of Brookhirst Switchgear, Ltd., comprises representative switchgear panels for the control of motors driving various classes of printing and allied machinery. In addition to the exhibit proper, some 45 Brookhirst panels are to be seen controlling presses in other parts of the Exhibition. Perhaps the most interesting design from the electrical point of view is the "Junior" solenoid type, in which the wedge-type automatic starter eliminates the sliding-face contact and substitutes a contact of the combined butt and sliding type. The fixed contacts of the starter consist of spring-controlled self-adjusting carbon blocks carried in suitable holders. The design secures, it is claimed, immunity from serious burning of the fixed contacts and of the short-circuiting contact bar, due to the fact that the initial connection on each step is established on the "full-face" and not at the edge of the carbon block. The controlling mechanism for the starter takes the form of an eddy-current retarder—a device which possesses the ideal characteristic of proportioning the starting period in accordance with the starting load. The time of starting is proportional to the load on the motor, which latter accelerates rapidly under light loads and slowly under heavier loads. Through

the provision of a one-way clutch, retardation is not applied during the downward movement of the solenoid core, which is thus free to fall to "off" immediately the solenoid is de-energised. In addition to the inherent automatic braking

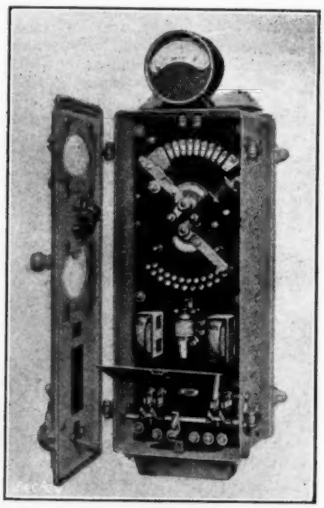


Fig. 5.—Hand-operated Press Control Panel.

effect, the speed of travel of the solenoid is variable by means of an adjustment of the poles of the electro-magnet. In addition to the starter proper, the control gear comprises a single-pole inching contactor, double-pole "safety first" isolator and a speed regulator complete with accelerator. This type of panel is controlled by start, inch and stop push buttons at the operating position. The panel is reasonably compact, having been specially designed for printing service, and particularly for flat-bed presses.

Examples are to be seen controlling "Perfector" and Miehle presses on the stand of Linotype & Machinery, Ltd., controlling offset presses on the stand of Waite & Saville, controlling a Miehle press on the stand of H.T.B., Ltd., and so on. A special adaptation of this type of gear is employed for controlling the four-roller two-revolution press and the No. 70 cutter and creaser on the stand of the Miehle Printing Press & Manufacturing Co., Ltd. In these cases, in addition to the switchgear already detailed, the control panel includes a small starter, also push-button operated, for the feeder motor. The control station on the press consists of five push buttons—start, inch, stop, feeder on, and feeder off.

For the "Mann" offset machine, the control panel is usually of the hand-operated type, fig. 5, and consisting of a hand-operated faceplate starter, hand-operated regulator, and main switch with fuses. This type of control gear does not involve so many points of technical interest, but attention must be drawn to the fact that the main switch acts also as an isolator, thus making it very difficult to expose "live" parts. A number of such control panels are in use on the stands of George Mann & Co., Ltd., and John & Wm. Burt & Sons, Ltd. For the platen press on the stand of John Haddon and Co., a similar type of control panel is employed, but without a speed regulator. Similar hand-operated control panels—again without speed-regulation facilities—are also employed for auxiliary machinery such as guillotines, box-making machinery, and the like. Examples of corner staying machines so controlled are to be seen on the stand of M. C. Ritchie, Ltd.

Larger control panels—both hand-operated and automatically controlled by push buttons—are shown on the Brookhirst stand, as well as parallel designs for the a.c. drives. Photographs of equipments for small and large rotary presses are also on view, and altogether the exhibit constitutes a very effective proof of the extent to which the company's gear of a specialised type has been developed for practically every type of drive in the printing and allied trades.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments. Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Budget.

On Monday last Mr. Winston Churchill, Chancellor of the Exchequer, opened his Budget for the ensuing year before the House of Commons. In the course of his speech he maintained that during the last five years the country had made a steady advance. Unemployment could not be reduced to normal proportions by the mere spending of large sums of borrowed money. In the Government's view this could only be done by the revival of industry as a whole, and especially by the revival of the basic industries. Referring to the de-rating scheme, he said that it was proposed to apply the relief at once to the agricultural industry. Income tax and super-tax would remain unchanged. The whole of the tea duty would be remitted, and certain concessions would be made in motor vehicle duties. The Chancellor, however, introduced a proviso that in future vehicles would only be considered electric vehicles for the purpose of the duty if the electrical motive power was derived from a source external to the vehicle or from a storage battery not connected with any source of power while the vehicle was in motion. After dealing with certain changes in betting and licensing taxation, the Chancellor proceeded to announce concessions with regard to the telephone service. It was proposed to extend from 1½ to 2 miles the radius from the nearest exchange within which a telephone is provided without extra mileage charge, and to provide call offices without charge or guarantee at about five-sixths of the rural post offices and railway stations not already equipped.

Ultra-Violet Trades Association.

We are informed that, as a result of a recent meeting, a body has been constituted under the title of the "Ultra-Violet and Allied Trades Association," consisting of a number of the leading firms engaged in the design, manufacture and marketing of ultra-violet, physic-therapy, and other electro-medical apparatus in this country. The Secretary of the Association is Mr. C. Rodgers, O.B.E., B.Sc., M.I.E.E., and the offices are situated at Kern House, 36, Kingsway, London, W.C.2. The objects of the Association are:—

(*a*) To promote a closer co-operation between manufacturers with a view to improvements in apparatus;
(*b*) To provide a medium through which the manufacturers may be taken into consultation by the profession on points affecting their mutual interests; and
(*c*) To form a clearing house for information on all points affecting the technical and constructional aspects of electro-therapy, and to foster the development of this important branch of medical science.

The Association feels that it can render much useful service to the profession, and any comments or suggestions will be welcomed.

British and American Aluminium Prices.

The Federal Trade Commission was informed last week that the British aluminium industry, by underselling American manufacturers of aluminium, has made large inroads into the business of American producers. An official of a large manufacturing company of Sidney, Ohio, gave evidence that his company for several years had bought its supply of aluminium from British concerns, although ten years or more ago the Aluminium Company of America had supplied the metal. He added that the British metal was more satisfactory for the manufacture of thin aluminium ware.—*Reuter* (Pittsburgh).

Large Russian Orders.

According to a Moscow report dated April 8th, the foreign orders for the first instalment of the projected great hydro-electric works on the River Dnieper, which is now in course of construction, have just been placed. Although international tenders were invited from, among others, German firms, none of the large orders has been allocated to the latter. A contract for steelwork has been awarded to the Wittkowitz Ironworks, Czecho-Slovakia; the generators are to be supplied by the General Electric Co. (United States) within the limits of the five years' credit scheme, and the turbines by the American Newport News Co. The management of the Dnieper undertaking is in the hands of the Russian engineer M. Winter, who has the technical assistance of Mr. Cooper, an American

engineer, and of the German Siemens Bau-Union. Before the allotment of the orders the managers of the undertaking paid visits to Germany, Sweden, Switzerland, and America. It is stated that the German share in the technical assistance has not had any effect in the placing of orders in Germany, while the expectations of the Siemens Bau-Union, through the establishment of an office in Moscow for giving technical aid, have also been unfulfilled because, as a German report says, in the allotment of orders apparently other considerations than economics frequently play a part.

Book Notices.

"The South African Mining and Engineering Year Book and Directory, 1929." (Pp. 628, illustrated.) London: Argus South African Newspapers, Ltd. Price £1 1s.—This edition of the year book has been brought up to date and, as usual, contains a number of sections likely to be of interest and use to electrical exporters who do, or desire to do, business with South Africa. We may especially mention the list of mining, municipal, railway and industrial buyers, with the names of the concerns for which they purchase, and the list of mining and industrial companies. There is again an electrical section, occupying 18 pages, in which new power station installations are described, the progress of automatic telephony is dealt with, and a table giving particulars of the public electricity supply undertakings is included.

"The *Journal* of the Royal Technical College, Glasgow." Vol. 2, Part 1, January, 1929, pp. 155; illustrated. Price 10s. 6d.—It has been decided that the first four issues (1924-27) shall constitute Volume 1 of the *Journal*, and that the fifth issue, which is dated January, 1929, instead of December, 1928, shall be designated Volume 2, Part 1. This part contains the abstract of a paper by Mr. M. G. Say, Ph.D., on the "Design of High-voltage Condenser-type Insulator Bushings."

"Relay Automatic Telephones." Pp. 31; figs. 14. London: Relay Automatic Telephone Co., Ltd.—A well-illustrated brochure descriptive of the company's public exchange system, including full details of the automatic network recently completed in Moravska-Ostrava, an important industrial centre of Czecho-Slovakia.

"The Post Office Engineers' *Journal*." Vol. XXII. Part I. April, 1929. London: Electrical Review, Ltd. Price 1s. 3d. net.

"Sir Joseph Wilson Swan, F.R.S.: A Memoir by M. E. S. and K. R. S." Pp. 183; illustrated. London: Ernest Benn, Ltd. Price 7s. 6d. net.

"Electric Wiring Theory and Practice," by W. S. Ibbetson. Third edition. Pp. viii+424; figs. 208. London: E. & F. N. Spon, Ltd. Price 7s. 6d.

Australian Investigators Entertained.

The members of the British Economic Mission who recently returned from Australia were welcomed home at a dinner given by the High Commissioner for Australia (Sir Granville Ryrie) at Australia House, London. Sir Arthur Duckham, the leader of the Mission, was prevented by illness from attending, and the Prime Minister, who had been invited, was also unable to be present. Responding to the health of the Commissioners present, Sir Hugo Hirst referred to the way in which any advantage likely to accrue from tariff increases was swallowed up by wage increases. The Mission had succeeded in persuading the employers and employed to meet and discuss their differences. He emphasised the fact that Australia could not solve her problems unaided. It was necessary to treat them as Empire matters and to secure the aid of our most prominent scientists, engineers, financiers, and industrialists in finding solutions.

Price Increase.

The BENJAMIN ELECTRIC, LTD., announces that, owing to the increased cost of raw materials, it is compelled to advance the prices of certain "Benjamin" electric light fittings by 5 per cent. as from April 15th, 1929. We understand that this increase has been applied by other manufacturers.

Trade Papers Amalgamate.

The amalgamation will take place as from May 1st of "The Engineer," Ltd., proprietors of our contemporary, *The Engineer*, and Morgan Bros. (Publishers), Ltd., proprietors of the *Ironmonger* and *The Chemist and Druggist*. The new company to be incorporated for effecting the amalgamation will be known as Morgan Bros. (Publishers), Ltd., will have a capital of £500,000, and its registered offices will be at 42, Cannon Street, E.C. The publishing offices of all the journals will remain unchanged for the present, and the policy that each has established over a very lengthy period will be maintained.

Electricity in Betting.

As electricity has penetrated practically every sphere of human activity, it is not surprising that it should find applications in the field of sport. The "electric hare" has had a considerable vogue, but the latest departure, and an innovation so far as this country is concerned, is the electrically-operated totalisator. Among the contracts placed recently for totalisator equipment by the Racecourse Betting Control Board is one for electrically-operated machines awarded to GRAHAM AMPLION, LTD. It is strange that loud-speaker manufacturers should be a means of displacing the too-vocal bookmakers.

Proposed American Cable-Wireless Merger.

The proposed amalgamation of the Radio Corporation of America's subsidiary, Communications Incorporated, with the International Telephone and Telegraph Company, is prohibited under the last radio law. The proposed merger, which is the outcome of the present policy of the American wireless and cable companies of combining against the British cable and wireless merger, was announced several weeks ago. —*Reuter* (Washington).

The C.M.A. Football Cup Final.

The final tie for the Cable Makers' Association Football Cup will be contested on Saturday next (April 20th) at the Woolwich Stadium, Woolwich Common, between teams representing the Anchor Cable Co., Ltd., of Leigh (Lancs.), and Standard Telephones and Cables, Ltd., of London. The time for the "kick-off" is 3.30 p.m., and admission to the match will be free. Callender's Cable Works Band will provide music. This is the first appearance of the London team in the final round, and as the Lancashire team are past holders (winning the cup in 1927), a keen contest is anticipated. This competition was founded in 1924 to provide additional opportunities for the employés of the cable-making industry to meet together socially, and to promote a friendly sporting rivalry between them. At the conclusion of the match, the fifth annual dinner will be held at 6.30 p.m. at the "Welcome Inn," Well Hall Road, S.E.9.

Radio Trade Meetings.

The annual meeting of the Radio Wholesalers' Federation was held at the Connaught Rooms, London, on April 10th, Mr. E. W. Houghton (the chairman) presiding. In moving the adoption of the report, the chairman said that the membership was already practically 50; the number might well have been doubled had not the Council paid strict regard to the principles upon which the Federation was founded. Applicants had to have clean sheets in respect of price-cutting, and their retail business (if any) had to represent an extremely limited proportion of their turnover and be quite separate. The whole future of the Federation depended upon the maintenance of those standards by the members. The list of approved wholesalers which the Council was preparing would no doubt be welcomed by many manufacturers who desired to deal equitably with the distributing trade. In referring to negotiations with the Radio Manufacturers' Association, the chairman said that relations were somewhat hampered by their inability to deal with the R.M.A. as a body on certain questions. In a subsequent discussion a member urged that the Radio Exhibition should be held on a more suitable date from the trade point of view, or, in the alternative, that a preliminary trade show should be held in May or June. Another member suggested that there should be a trade day at the Exhibition. Attention was called to the fact that valves were still being sold at "cut" prices, and it was suggested that they should be marked in such a way as to leave no doubt of the source from which they emanated. After the adoption of the report, there was a ballot to fill three places on the Council. As a result the following were elected:—Mr. E. H. Burris (F. Burris & Sons, Bristol), Mr. E. U. Redway (Southern Motor Factors, Ltd.), and Mr. J. W. Riddiough (F. Riddiough & Son, Bradford). Mr. A. G. Beaver initiated a discussion upon methods of investigating the status of retail applicants for trade terms. He suggested that a form bearing the imprint of the Federation and universally adopted would be the most suitable arrangement. The chairman asked members to send in copies of the forms which they used and a description of their methods so that the best possible form could be evolved.

On the same day the annual meeting of the Wireless Retailers' Association was held at St. Bride's Institute, E.C.4. Mr. F. S. Horsey (chairman) presided, and in submitting the annual report said that in the last six months the membership had about doubled. The elimination of "dabbling" and the granting of discounts to unauthorised persons was a difficult matter. A prime essential was the combination of all reputable wholesalers in one body, and he was glad to say that the Radio Wholesalers' Federation had been formed and was working in co-operation with the Association. This was bound to have far-reaching consequences to the trade. Many new branches of the Association had been formed and several existing bodies had become affiliated.

Cable Manufacturing in Poland.

The Polish branch of the Skoda Works Co., of Pilsen, Czecho-Slovakia, established some three years ago for the construction of electric motors and motor vehicles, has lately opened a section for the manufacture of telephone cables at Okenicio, near Warsaw, Poland now possesses three cable factories, the others being at Bydgoscz and Cracow.

New Italian Companies.

Among the companies recently formed in Italy are the Società Italiana Diffusione Applicazione Elettrodomestiche, Turin, capital 100,000 lire; La Società Elettrovie Romagnole, Bologna, capital 5,000,000 lire; and La Compagnia Forni Elettrici Automatici, Milan, to manufacture electric furnaces.

A Polish Travelling Exhibition.

The Polish Association of Central Electricity Stations has recently dispatched on a tour of the country a travelling exhibition of electrical appliances for domestic and small industrial use with the idea of making their advantages better known to the general public.

Irish Free State Electrical Imports.

The imports of electrical goods, excluding machinery, into the Irish Free State during February last amounted to £30,886, bringing up the total for the first two months of the year to £71,690, as compared with £81,362 in the corresponding period of 1928.

Bankruptcy Proceedings.

J. Harrison, 144, St. Mary's Road, Prittlewell, Essex, dealer in electrical fittings.—The receiving order herein was made on March 14th on the debtor's own petition, and according to the statement of affairs there are liabilities of £1,393, against assets amounting to £23, leaving a deficiency of £1,370. The debtor attributed his failure to depreciation of shares in a limited company, liability under a judgment for a partnership debt, and law costs. He commenced trading in partnership in September, 1924, providing stock estimated at £300, purchased with moneys lent him by his wife, which amount is still owing. His partner provided £300 in cash. In 1925 a limited company was formed with a nominal capital of £600. The debtor was allotted 300 £1 shares in consideration for his interest, and was appointed a director of the company. As a result of the general strike in 1926, the company lost the greater part of its business, and in March, 1927, discontinued trading. He and his former partner afterwards carried on business at the debtor's present address until March, 1928, when the partner withdrew from the business. In March, 1926, the debtor and his former partner entered into a temporary agreement with another in connection with the sale of electric lamps, &c., on a profit-sharing basis, but illness prevented his carrying out the terms of the agreement, with the result that judgment was obtained against him and his former partner for the return of £50 which had been provided by the third party. The debtor had not kept any books of account, and states that he became aware of his position in August, 1926.

E. F. Lee, electrical engineer, 340a, King's Road, Chelsea.—The public examination of this debtor was held at the London Bankruptcy Court on April 12th before Mr. Registrar Francke, the accounts showing liabilities of £385 against assets valued at £106. Replying to the Official Receiver, debtor said that after having served approximately ten years in the army, he resigned, receiving a gratuity of £1,000. He started business in partnership under the style of "Francis Mewton," and provided £700 as capital. The trading from its inception was unsuccessful, and his partner retired in July last, receiving £27 for his interest. Witness attributed his failure and insolvency to bad trade, heavy overhead expenses, and bad debts. The examination was concluded.

T. C. Wheeler, 6, South Scarborough Street, lately 30, Stockton Street, West Hartlepool, electrician.—The public examination herein was to have been held on April 11th at the Court House, Stockton-on-Tees, but the debtor did not attend. It was stated that there was a deficiency of £139, and that the debtor attributed his failure to his earnings not having been sufficient to maintain his family, and having to pay heavy interest on loans. The examination was adjourned.

S. W. Richards, radio engineer and electrical contractor, Blackwood Radio and Electrical Supply Depôt, High Street, Blackwood, Mon.—Receiving order made April 3rd, on debtor's own petition. First meeting April 19th, at 34, Park Place, Cardiff. Public examination, May 23rd, at the Town Hall, Tredegar.

C. K. Wallis, electrical engineer, Bedford Street and Longford Road, Bognor, Sussex.—Supplemental dividend of 3s. 8d. in the £, payable at the Official Receiver's office, 12a, Marlborough Place, Brighton.

B. Smith (H. Worton), electrical engineer, The Crescent, Spalding.—Trustee, Mr. C. E. Turton, 4 and 6, West Street, Boston. Appointed April 9th.

M. Kelly, radio apparatus dealer, 12, Jackson's Row, Manchester.—Trustee, Mr. J. F. Warburton, 28, Queen Street, Manchester, released, January 16th.

H. B. Powell, wireless dealer, 10, Union Street, Hereford.—Last day for proofs for dividend, April 26th. Trustee, Mr. O. B. Wallis, Official Receiver, 133, St. Owen Street, Hereford.

R. Yeend (Central Electrical Works), electrician, 57, West Street, Wisbech, and Red Lion Street, Spalding.—Last day for proofs for dividend, April 26th. Trustee, Mr. F. H. Langmaid, Official Receiver, 41, Sidney Street, Cambridge.

Company Liquidations.

W. J. Hilland & Co., Ltd., 9, Linenhall Street, Belfast, electric lamp factors, &c.—The creditors in this matter met recently in Belfast, when a statement of affairs was submitted which showed ranking liabilities of £2,875 and net assets of £357, leaving a deficiency of £2,518. The company was registered in May, 1928, when it took over an existing business. Debentures amounting to £1,500 were created, but £1,300 had been paid off. No offer was submitted to the creditors, and it was decided that the voluntary liquidation of the company should be continued. The following are creditors:—

	£		£
International Lamp Co., Ltd.	111	Central Sewing Machine Co.	52
Chloride Electrical Storage Co., Ltd.	78	Harper & Pettigrew ...	50
Bae & Rempel	66	Lees, Hyman & Lees ...	43
		Adler Machine Co. ...	40

Helikon Wireless Co., Ltd., 6, Park Royal, North Acton, Middlesex.—The winding-up order herein was made recently, and according to the statement of affairs filed, there are liabilities amounting to £1,187 against assets of £23. The first meeting of creditors was held recently at 29, Russell Square, W.C.1. The following are creditors:—

	£		£
J. M. Naylor ...	1,061	Nox Electrical Lamp Works	36
Van Heteran & Co. ...	23		

Oxford Wireless Telephony Co., Ltd.—Winding up voluntarily. Liquidator, Mr. E. R. White, 55, Cornmarket Street, Oxford. A meeting of creditors was to be held on April 18th, at the office of the liquidator.

Handcross Electricity Co., Ltd.—A meeting of members is called for May 13th at The Market Hall, Redhill, to hear an account of the winding up from the liquidator, Mr. A. R. Thompson.

Private Arrangements.

S. K. Y. Cochran, wireless dealer, trading as the Popular Wireless Stores, 26, Moorfields, and 3, Byrom Street, Liverpool. A meeting of creditors was held on April 5th at the offices of Mr. P. S. Booth, 2, Bixteth Street, Liverpool, when the representative of the Chorlton Metal Co. was elected to the chair. The statement of affairs submitted showed ranking liabilities of £894, and net assets of £180, leaving a deficiency of £714. Mr. Booth reported that the debtor commenced trading with a capital of £350, the whole of which was borrowed, and was still owing. The business was satisfactory, and in February last he opened a branch shop. The takings at the original establishment had ranged from £50 to £60 a week, and the takings at the branch shop from £5 to £6 a week. The debtor's drawings had been at the rate of £6 a week. A resolution was passed confirming a deed of assignment already executed to Mr. Booth, and a committee of three of the creditors was appointed. It was also decided that the debtor should be given 14 days in which to submit an offer of a composition. The following are creditors:—

	£		£
Humphrey Bros.	26	Accumulators Elite ...	29
Hewitt & Co.	23	Charlton Metal Co. ...	104
Lever, E. T., (Trix), Ltd.	60	Cossor, A. C., Ltd. ...	29
Luhtenberg & Jones, Ltd.	26	Victor, T., Ltd.	23

Dissolutions of Partnership.

Bentley-Hunt & Vanstone, electrical and radio engineers, 4, Wood Street, Bath.—Mr. J. E. Bentley-Hunt and Mr. C. P. Vanstone have dissolved partnership. Mr. Bentley-Hunt will attend to debts and continue the business, but not under the same firm name.

H. G. Westlake, electrical and wireless engineer, 16, Fountain Street, Halifax.—Mr. H. G. Westlake and Mr. A. S. Waterton have dissolved partnership. Mr. Waterton will attend to debts and continue the business under the same style.

Aldrich & Butland, electrical engineers, 6, Castle Street, Ruthin.—Messrs. E. G. & D. A. Aldrich and R. E. Butland have dissolved partnership.

Henley's Staff Dinner.

On Saturday evening last the staffs of W. T. Henley's Telegraph Works Co., Ltd., and Henley's Tyre and Rubber Co., Ltd., met at dinner at the Great Central Hotel, Marylebone, N.W. Mr. Percy Rosling presided over a record attendance—about 500—from all departments of the companies. After the loyal toast, Mr. W. G. Smale (secretary of the Tyre Co.) proposed the toast of "The Cable Company." He briefly reviewed the progress which he had seen the company make during his service over a period of 30 years, and said that after a bad period the Tyre Co. was forging ahead.

In responding, Mr. Rosling said that his association with the company went back 42 years, when the staff was fewer than a dozen; to-day it numbered over a thousand. He pointed out that the interests of the board, the management, the staff, and the workpeople were all bound up together. The secret of success was to give a little more than one was expected to give. He wondered what the position of the company would be in 42 years' time, and said that the chair would then most probably be occupied by one of the young men present—or even one of the young women.

Sir George Sutton (chairman of the company) said that he had been able to come at the last moment. The company had entered upon its 50th year, although the business had existed in one form or another for upwards of a hundred

years. He and Mr. W. J. Potter were the only original members now living; he regretted that ill-health prevented Mr. Potter from attending; they wished him a speedy recovery, for he was a man beloved by all at Henley's. He thought that the company's past was a guarantee of its future success. An important factor in its advance had been its system of humanised labour.

Mr. W. F. Bishop proposed the toast of "The Tyre Company," and in a humorous manner dealt with "Tyres and the Ordinary User." He said that the company had pulled through its bad times, and he hoped that its prosperity and progress would continue. Mr. J. Traxler replied to the toast, stating that 1928 had been a record year for the company, while the business so far this year pointed to even better results.

The remaining toasts were "The Ladies," proposed by Sir Montague Hughman and replied to by Mr. P. Dunsheath; and "The Chairman," proposed by Mr. E. Lefeaux.

Musical and vocal items were interspersed with the toasts, and after dinner there was a most enjoyable dance in the Winter Garden of the hotel.

Works Visit.

A visit to the works of the London Electric Firm, Croydon, was recently made by members of the Regent Street Polytechnic Engineering Society. The visitors were shown details of what the company claims to be the largest searchlights in the world, which have three separate methods of control, namely, hand local control, pan-handle control, and electric distance control. They also inspected the mobile combined beacon floodlight for aerodromes, as used at Croydon.

Income Tax on Hire-Purchase Transactions.

After 25 years of negotiation with the Income Tax Commissioners, the Hire Traders' Protection Association has obtained their approval of a new form of assessment which it is claimed will be of great advantage to the trade. The H.T.F.A. have engaged the Holborn Hall, Gray's Inn Road, W.C., for a meeting on April 24th, at 3 p.m., of hire traders, at which the new arrangements will be fully explained, and opportunities will be given for the clearing up of doubts and, if time permits, other questions of interest to hire trading will be discussed. Tickets can be obtained from Mr. S. J. Sewell, secretary of the Association, 27, Chancery Lane, W.C.2.

Electrically-heated Gold-blocking Machines.

For several years past the RAY MANUFACTURING CO., 25b, High Street, Wimbledon, S.W.19, has been engaged in commercial experiments in the conversion of gas-heated gold-blocking machines to electricity to procure flexibility of temperature control and eliminate noxious fumes. The firm has sent us a sample of its work in the form of a small leather fuse-wire case. This demonstrates the success of the process, there being no sign of burning or other defects common when gas is employed for the purpose.

New Catalogues and Lists.

X-RAYS, LTD., 47, Red Lion Square, W.C.1.—A very full descriptive brochure of the company's electro-medical apparatus, including X-ray couches, tubes and stands, quartz lamps, X-ray photographic apparatus, &c. Illustrated.

MESSRS. G. DIKKERS & CO. (ENGLAND), LTD., Avenue Chambers, Southampton Row, W.C.1.—Three illustrated leaflets, advertising, respectively, the company's portable h.p. testing transformer sets; induction regulators and phase shifters; and reactors.

THE BENJAMIN ELECTRIC, LTD., Tariff Road, Tottenham, N.17. —The "Benjamin Reflector" for March-April, dealing with the lighting of tobacco factories.

THE JACKSON ELECTRIC STOVE CO., LTD., 143, Sloane Street, S.W.1.—April calendar-blotter, advertising the Jackson "No. 46" electric cooking cabinet.

THE A.E.G. ELECTRIC CO., LTD., 131, Victoria Street, S.W.1.—April stock list of electrical machinery and appliances. Priced.

MR. H. C. SLINGSBY, 97, Kingsway, W.C.2.—List No. 366, containing illustrations and details of trucks, lifting apparatus, ladders, &c.

MESSRS. GEORGE COHEN, SONS & CO., LTD., Park Royal Road, North Acton, W.10.—An illustrated catalogue of drilling machines, lathes, milling machines, grinders and other machine tools of all makes.

MESSRS. ADAM HILGER, LTD., 24, Rochester Place, N.W.1.—Illustrated brochures dealing with Prof. Coker's photo-elastic apparatus for determining the distribution of stress in structural and machine members, and lateral extensometer and recording device.

Mr. J. MARTIN BLAIR, Audrey House, Ely Place, E.C.1.—A booklet dealing in some detail with the design and employment of the "Ramie" ceiling rose and the "Isola" safety connector. Illustrated and priced.

MESSRS. JOHN SHAW & SONS (WOLVERHAMPTON), LTD.—An illustrated circular setting forth details of the company's special selling scheme in connection with "Trojan" electric vacuum cleaners, including a hire-purchase arrangement.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—A neat illustrated pamphlet containing reduced prices of "Argenta" opal lamps and a sheet announcing other reductions.

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD., Holborn Viaduct, E.C.1.—A net trade price list (No. 20) of "C.M.A." and "Nonazo" cables, wires and flexibles.

SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., 38-39, Upper Thames Street, E.C.4.—Leaflet No. 251, arranged for overprinting, containing the reduced prices of the company's "Pearl" and "Silvalux" lamps.

MESSRS. LONG & CRAWFORD, LTD., 2, Gorton Road, West Gorton, Manchester.—Catalogue Section F, containing illustrated information regarding the company's self-isolating oil-immersed switch-fuses.

MESSRS. LANE & GIRVAN, LTD., Caledonia Stove and Electrical Works, Bonnybridge, Glasgow.—A first electrical list (No. 429), containing illustrated particulars and prices of "Caledonia" electric cookers, breakfast cookers, boiling plates and bowl fires, the first of a range of domestic and commercial appliances.

The ELECTRIC HEATING CO., George Street, Croydon.—Priced and illustrated pamphlets advertising "Elect" fires, egg boilers, coffee percolators and soldering irons.

MESSRS. C. A. VANDERVELL & CO., LTD., Acton, W.3.—A wall chart of replacement batteries for all makes of British and foreign vehicles.

The FULLER ACCUMULATOR CO. (1926), LTD., Woodland Works, Chadwell Heath, Essex.—List No. 103, containing full details, illustrations and prices of "Sparta" batteries for automobile lighting, starting and ignition.

Glareless Electric Lamps.

The recent reductions in the prices of "Pearl" electric lamps were designed to encourage the use of this glareless lamp in preference to the clear-glass type, and in pursuance of this policy the Lighting Service Bureau has arranged for lectures on the advantages of glareless lamps to be delivered in the principal centres of the country by Messrs. W. J. Jones and H. E. Hughes.

The advantages of "Pearl" lamps from the retailer's point of view are set out in a pamphlet which the Electric Lamp Manufacturers' Association has circulated. Briefly, these are: A smaller range permitting some degree of standardisation and reduced stocks; higher profit; and protection in competition with non-Association lamps. Standardisation is further encouraged by the extra reduction in the prices of 230-V lamps.

The Leipzig Spring Fair.

In the review of the above-named Fair in our April 6th issue our correspondent mentioned "Tenazit." The word should have been "Tenacit," which is the name of the whole range of synthetic and mineral moulding compounds manufactured by the A.E.G.

Recent Contracts.

A sign of the progress of Sheffield industry towards recovery may be discerned in the new electric power station to be built at Blackburn Meadows, which will eventually supersede the war-time emergency station in the same locality and the older Neepsend Station. The new power station is one of the "selected" stations under the 1926 Electricity Act, and will form part of the Mid-East England scheme which has recently been adopted by the Central Electricity Board. An order for the first generating unit, amounting to nearly £100,000, has been placed with the ENGLISH ELECTRIC CO., LTD., who will manufacture the 35,000-h.p. multi-cylinder steam turbine at its Rugby works and the electric generator at Preston. The generator will have an output of 25,000 kW, and will run at 3,000 r.p.m. The condensing plant is included in the contract, and an "English Electric" shunting locomotive is also being supplied for the haulage of coal, ashes, &c.

The 66,000-V switchgear recently ordered from the BRITISH THOMSON-HOUSTON CO., LTD., by the Central Electricity Board for the South-East Electricity Scheme is required in connection with the inner London network of the national "Grid." The switchgear is of the "indoor-outdoor" type, and each oil-immersed circuit breaker is rated at 600 A, with a rupturing capacity of 1,500,000 kVA. The buildings housing the switchgear have three floors, the two upper being glazed and provided with access facilities at each end, the lower being unenclosed but having a retaining wall from end to end. The circuit-breakers are located on either side of this wall, the busbars and busbar isolating switches being in the two enclosed floors above. All busbars are in duplicate on each site. Oil-filled bushings of special construction are used where the connections pass through the floor of the top chamber. In most instances copper tube is used for the connections, and all isolating switches are remote operated from ground level, a comprehensive system of interlocks preventing danger to operators. The oil circuit-breakers are of the multi-break type, each phase being self-contained in a cylindrical tank mounted on a frame structure. Purification of circuit-breaker oil is carried out by equipments provided on each site, without removal of any single unit being necessary, but, by means of motor-operated tank trucks, circuit-breaker tanks and complete single-phase units can be removed for inspection. Special electrical tubular heaters are also included to ensure that the temperature of the busbar chambers is kept above that of the surrounding atmosphere.

Two contracts totalling £700,000 in value have been placed with the METROPOLITAN-VICKERS ELECTRICAL CO., LTD. One

is for equipments for the extended electrification of the Buenos Aires suburban lines of the Central Argentine Railway, and the other for equipments for the north-western section of the 132,000-V transmission scheme of the Central Electricity Board.

Trade with Russia.

At the annual meeting of the Association of British Chambers of Commerce in London last week, Mr. W. L. Holland (Preston) asked leave to submit a resolution in which the visit of British industrialists to Russia was welcomed as likely to lead to the provision of employment in this country. It also called upon the Government to take all possible steps to resume relationships with Russia. After a brief discussion, in which Sir Stanley Machin pointed out that it was the Association's decision that trade with Russia should not be resumed until pre-war debts were acknowledged by the Soviet Government, leave to submit the resolution was refused.

Trade Announcements.

The Foster Engineering Co., Ltd., has opened a service store at 11, Fitzroy Square, W.1 (telephone: Museum 2412-3), where it will maintain stocks of "Apex" switchgear and Association lamps.

Messrs. Pritchett & Gold & E.P.S. Co., Ltd., have moved their Glasgow depôt to 45, Clyde Place. (Telephone: South 1246.)

Messrs. J. Dyson & Co., Ltd., have transferred their Hull branch to more commodious premises, with radio and electrical showrooms at 39, Beverley Road, Hull, immediately opposite their old address.

The business formerly carried on by Mr. G. Morrison is now conducted by Geo. Morrison (Electric Lighting and Plating), Ltd., at 22, Upper Talbot Street, Blackpool. Showrooms have been opened at 17, Station Road, Kirkham.

Southern Motor Factors, Ltd., states that it is about to open a wholesale electrical department at its Bournemouth branch, and asks for manufacturers' catalogues and quotations to be sent to 6, Avenue Lane, The Square, Bournemouth.

Prices of Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.	Price April 16th.	Fortnight's inc or dec.
a	Acid, Oxalic	per lb.	5½d.	...
a	Ammoniac, Sal	per ton.	£60	...
a	Ammonia, Muriate (large crystal)	,,	£52	...
a	Bisulphide of Carbon	,,	...	...
a	Borax	,,	£35	...
a	Copper Sulphate	,,	£25 10s.	...
a	Potash, Chlorate	per lb.	9½d. to 4d.	...
a	,, Perchlorate	,,	5½d.	...
a	Shellac	per cwt.	£13 10s.	...
a	Sulphur, Commercial	,,	£11	...
a	,, Roll	,,	£11	...
a	Soda, Chlorate	per lb.	3d.	...
a	,, Crystals	per ton.	£5 to £5 5s.	...
a	Sodium Bichromate, casks ...	per lb.	5½d.	...
	METALS, &c.			
b	Aluminium, Ingots	per ton.	£96 to £100	...
b	,, Wire	per lb.	1/1 to 1/9	...
b	,, Sheet	,,	1/1 to 2/9	...
p	Babbitts Metal and Anti-friction Metal—			
	Grade I	per ton net.	£188	£16 dec.
	Grade II	,, ,,	£132	£10 dec.
	Grade III	,, ,,	£74	£5 dec.
c	Brass (rolled metal 2" to 12" basis)	per lb.	11½	1½d. dec.
c	,, Tubes (solid drawn)	,,	1/1½ to 1/1½d.	1½d. dec.
c	,, Wire, basis	,,	11½	1½d. dec.
c	Copper Tubes (solid drawn) ...	,,	1/4	2½d. dec.
c	,, Bars (best selected) ...	per ton.	£119	£19 dec.
c	,, Sheet	,,	£119	£19 dec.
c	,, Rod	,,	£119	£19 dec.
d	,, (Electrolytic) Bars ...	,,	£99	£24 dec.
d	,, ,, Sheets ...	,,	£143 10s.	...
d	,, ,, Wire Rods ...	,,	£99	£22 dec.
d	,, ,, H.C. Wire	per lb.	1/-⅞	2½d. dec.
f	Ebonite Rod	,,	2/8 to 2/6	...
f	,, Sheet	,,	2/8 to 2/6	...
n	German Silver Wire	,,	3/2	...
h	Gutta-percha, fine	,,	nom.	...
h	India-rubber, Para fine	,,	1/0	½d. dec.
l	Iron Pig (Cleveland No. 3.) ...	per ton.	68/6	1/6 inc.
l	,, Wire, galv. No. 8, P.O. qual.	,,	£21	...
g	Lead, English pig	,,	£25 15	£2 dec.
g	Mercury	per bot.	£22 2s 6d. to £22 5s.	...
e	Mica (in original cases) small ...	per lb.	3d. to 8/-	...
e	,, ,, medium ...	,,	4/- to 8/-	...
e	,, ,, large ...	,,	10/- to 20/- & up	...
p	Phosphor Bronze, plane castings	,,	1/8¾	...
p	,, ,, drawn bars & rods	,,	1/5½	½d. inc.
p	,, ,, rolled strip & sheet	,,	1/4¼	...
p	,, ,, wire...	,,	1/7½	1½d. inc.
o	Platinum	per oz.	£13 17s. 6d.	...
d	Silicium Bronze Wire	per lb.	1/8	2d. dec.
r	Steel, Magnet. in bars	,,	7½d.	...
m	Tin, Block (English)	per ton.	£205 5s. to £205 10s.	£14 to £14 5s. dec.
m	,, Wire, Nos. 1 to 16	per lb.	8/11	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
l Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
W. F. Dennis & Co.

In their letter dated April 13th, Messrs. James Forster and Co. stated that a feature of the lead market last week was the appearance of a backwardation on prices, presumably owing to the fact that Mexican supplies have been delayed through the revolution, while shipments from Australia last month fell below normal. However, at present there is no shortage, whatever may happen in the future. A little buying has been done by consumers this week chiefly for early delivery, but until the market settles down on a stable basis more extensive buying cannot be expected. "It seems to us that an economic price for lead under present conditions is round about £24 per ton, but just as the advance was carried too far it is more than likely that the present fall will be overdone and prices temporarily decline below an economic level before the market eventually settles down."

A Name for Moulded Insulation.

The word "resoid" has been chosen from 521 suggestions submitted in the recent contest, sponsored by the Moulded Insulation Section of the National Electrical Manufacturers' Association (United States), to determine a generic name for moulded products. The Section having selected the name "resoid," will consider matters relating to its general adoption and use at its next meeting.

For Sale.

Messrs. Leopold Farmer & Sons will sell by auction on April 30th, at 79, Kilburn Lane, N.W., plant and machinery, including electric motors, &c. Coventry Corporation Electricity Department invites offers for two 3,000-kW steam turbo-alternators with condensing plant, four water-tube boilers with superheaters and chain-grate stokers, two c.i. fuel economisers, and one induced-draught plant The Central (Unemployed) Body for London invites offers for surplus lighting plants lying at Hollesley Bay Labour Colony, near Woodbridge, Suffolk. (See our advertisement pages to-day.)

Lighting and Power Notes.

Argentina.—Electrical Development.—According to the *Review of the River Plate*, plans are being prepared for the reorganisation of the services of the Compania Italo-Argentina de Electricidad. The scheme includes the erection of new power stations during the current year, at a cost of $60,000,000 paper. The largest of these stations will be erected at Bahia Blanca with distributing connections to Ingeniero White and Puerto Militar.

Barnard Castle.—Overhead Lines.—As the result of a petition from ratepayers, the Urban District Council has decided to withdraw for the present its consent to the erection of overhead lines by the Cleveland and Durham County Electric Power Co. for the supply of electricity to the town.

Bradford.—Change-Over.—The system of electricity supply is to be changed over from d.c. to a.c. in Upper Woodlands Road and district, at an estimated cost of £3,092.

Brazil.—Electrical Development.—A report on the water-power of Brazil, made for the Department of Transportation and Public Works, places the number of important waterfalls at 378, of which only 154 have been measured. The latter are estimated to have a power of at least 50,000,000 h.p., and it is believed that the remaining 224 would bring the figure up to a minimum total of 60,000,000 h.p. In addition to the larger waterfalls there are several sources having between 6,000 and 50,000 h.p. About 50 per cent. of the power used in Brazil is generated at 50 cycles and 50 per cent. at 60 cycles a.c. There are some relatively small plants in the north and south, where steam-power is employed, and at Puerto Alegre direct current is generated. It is proposed to replace these plants gradually by more modern installations generating a.c.—*Reuter's Trade Service* (Rio de Janeiro).

Burton-on-Trent.—Loans.—The Corporation Electricity Committee is applying for sanction to borrow £6,716 for the supply and laying of cables from the power station to the new factory of Messrs. Pirelli, Ltd., on Derby Road; £782 for switchgear at the factory sub-station, and £1,360 for switchgear at the power station in connection with the supply.

Canada.—Hydro-Electric Development.—Details of an important hydro-electric development in Northern Ontario were laid before the Provincial Legislature during the Budget debate by the Hon. J. R. Cooke, Government Representative on the Hydro-Electric Power Commission of Ontario. The plan involves the connecting-up by h.p. transmission lines of 16 power sites, affording a total development of 570,900 h.p. The map also shows a proposed transmission line stretching for nearly 200 miles from North Bay to Toronto. It is proposed on this line to transmit power surpluses over and above the industrial requirements of the north to the Georgian Bay and

Niagara distribution systems of the Commission, where the power demand is constantly growing. The first step in the proposals to tap the water power of the north has already been taken in the purchase of the Wahnapitae plant from the Wahnapitae Power Co., Ltd., which, with extensions, involves an expenditure of $2,700,000. This plant will yield 13,300 h.p. Four proposed plants on the upper waters of the Ottawa River would yield 265,000 h.p., while two on the Mississaga River are indicated at 115,000 h.p. Intervening sites along the proposed 275-mile stretch, taking in the Petawawa, French Maganatawan, and Spanish Rivers, would make up the total of 570,900 h.p. in the new super-power belt.

It is anticipated by engineers of the Hydro-Electric Power Commission of Ontario that within the next seven years all the rural homes in old Ontario which can be economically served by transmission lines will have a connection available. In 1923 only 320 miles of rural power lines existed. Last year alone 960 miles were erected, and this year the mileage added will be 1,200. The Commission is being urged to bear, with the consent of the Union of "Hydro" Municipalities, all the maintenance costs on rural transmission lines now paid by the consumers, and which amounts to about $66 per year per mile of line. If the Government or the Commission paid it the average service cost would be brought down to about $1.50 per year per consumer.

Carlisle.—Loan Sanctioned.—The Corporation Electricity Committee has received sanction to the borrowing of £100,000 in respect of additional plant. The Electricity Commissioners have intimated that they will be prepared to consider the sanctioning of further amounts in respect of this application upon receipt of a revised estimate of cost, based upon tenders accepted, or proposed to be accepted, for the various works concerned.

Chesterfield.—Electricity Supply.—At the last meeting of the Corporation the following business was transacted. The question of supplying electricity to Grassmoor Village was adjourned for twelve months. The borough electrical engineer (Mr. D. H. Davies) submitted a report on the lighting by electricity of the main roads in the borough, and this report is to receive further consideration. The town clerk was authorised to inform the Central Electricity Board that, after due consideration, the Corporation perfers its undertaking to become a "temporary arrangement" station instead of a selected station in the Mid-East England Electricity Scheme, and the Central Electricity Board has agreed to the request.

Colchester.—Loan.—The Town Council has applied for sanction to a loan of £50,000 for prospective works in connection with the extended area of supply.

East Ham.—New Cables.—The Corporation Electricity Committee has approved an estimate of £7,290 for laying distributor cables in various streets.

Finchley.—Electricity Extensions.—At a recent meeting of the Urban District Council Electricity Committee, the chief electrical engineer reported that, owing to the abnormal increase of over 1,400 kW in the demand during the last two years, it is essential that more substantial and immediate provision should be made for the next winter than has been done during the last two years. The increased demand has been more particularly confined to the central portions of the district. He proposes, therefore, to utilise the site and adapt buildings in Hamilton Road by looping in the Hill Rise h.p. feeder and installing rectifying plant with a capacity of 300 kW, also by installing 300 kW on the Percy Road site, an additional 300 kW on the Holly Park site, and 150 kW on the Hill Rise site. A h.p. main at present terminates in Hill Rise sub-station and another at Holly Park sub-station. He proposes to join these together by a h.p. main between Hill Rise and Holly Park, this forming a loop. The cost of the h.p. and l.p. mains is £7,320, and sub-station buildings, h.p. and l.p. switchgear, rectifying plant, &c., £12,465.

Glasgow.—Dalmarnock Station.—At a meeting of the Corporation Electricity Committee on April 12th it was reported that from May 1st the Dalmarnock power station, which is one of the stations selected by the Central Electricity Board, will be worked for the Board. Under the scheme the Corporation will operate the station to the Board's requirements and will purchase electricity required for the supply of consumers in the city.

Gravesend.—Mains Extensions.—The Corporation Electricity Committee is to carry out mains extensions, at a cost of £4,150.

Hastings.—Loan Sanctioned.—The Corporation Electricity Committee has received sanction to a loan of £1,000 for mains and sub-station equipment in connection with the supply to Peasmarsh.

Hull.—New Plant.—The Corporation Electricity Committee has authorised the purchase of a 12,000-V switchboard at a cost of £475, two sets of televisory remote control equipment at £950, and two 500-kVA special transformers at £1,270.

Irish Free State.—Queenstown.—The Urban District Council has instructed the town clerk to write to the Minister for Industry and Commerce, requesting him to hold an inquiry into the charges made by the Cork Electric Supply Co.

Leeds.—Loans Sanctioned.—The Corporation Electricity Committee has received sanction to borrow £400,000 for provision of mains, £50,000 for sub-station equipment, and £50,000 for the wiring of consumers' premises in connection with the assisted wiring scheme.

Manchester.—Progress During February.—During the month of February the Corporation electricity undertaking showed an increase in connections of 1,804 kW, bringing the total up to 373,848 kW; and the number of applications received for supply, including those for additional supplies, was 1,054, representing a total of 1,995 kW. The number of hired cookers connected increased by 31, bringing the total of hired cookers actually connected to 5,112. Applications for the hire of cookers totalled 89. A new sub-station was put into commission at Fairfield, and additional plant installed at four existing sub-stations. The change-over from d.c. to a.c. had been completed in the cases of 4,581 consumers, work was in progress involving 1,290 consumers, and sanction had been received in respect of an additional 235 consumers.

Masham.—Sale of Undertaking.—The Urban District Council at its last meeting adopted recommendations of the Electricity Committee to dispose of the Council's electricity undertaking to the Cleveland and Durham County Electric Power Co. The transfer is to be carried out forthwith.

Special Orders.—Applications have been made to the Electricity Commissioners for Special Orders by the East Grinstead Urban District Council authorising it to supply electricity in certain parishes in the rural district of Godstone, and Mr. W. G. Heath to supply electricity in the urban district of Ivybridge and parts of the rural districts of Kingsbridge and Totnes.

The Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the South Somerset and District Electricity Co., Ltd., to supply electricity in part of the rural district of Axminster, and the Shropshire, Worcestershire and Staffordshire Electric Power Co. to supply in the urban and rural districts of Bromyard and part of the rural district of Ledbury.

Tunbridge Wells.—Loan.—The Town Council has applied for sanction to a loan of £13,302, for mains, sub-station, sub-station pillars, &c.

Weymouth.—Loan Sanctioned.—The Corporation Electricity Committee has received sanction to the borrowing of £1,355 in respect of the Upwey, Wyke Regis, and Two-Mile Coppice sub-station buildings and sites.

Tramway and Railway Notes.

Bournemouth.—Year's Working.—The Corporation tramway undertaking during the year ended March 31st last, carried 32,171,930 passengers, the gross receipts being £227,187. These figures represent a decrease of only 286,452 passengers and £2,293 in receipts, in spite of the fact that since January 1st last one route to Poole has been abandoned in favour of motor-omnibuses. A contribution of £2,000 is to be made to the borough fund.

Bradford.—Railless Cars.—An inquiry was held by Mr. A. D. Erskine, for the Minister of Transport, on April 10th and 11th, into the application of the Corporation to run railless cars on 40 routes, 29 within the city and 11 outside. For the Corporation, Mr. J. G. Gunter said that objections against the proposals of the Corporation in respect of the 11 routes outside the city had been lodged by the West Riding County Council, Pudsey Corporation, and the Urban District Councils of Birkenshaw, Calverley, Farsley, Hipperholme, Hunsworth, and Shipley. No objection had been raised to the 29 routes within the city boundary, and consent had been given already in respect of the routes outside the city by the Queensbury, Clayton, Drighlington and Bingley Urban District Councils, and by the Halifax Rural District Council. On all of the 40 proposed routes, with the exception of eight, tramways were in operation. The eight to which he had referred would be in the nature of connecting links. It was proposed to convert the tram routes to railless-car routes as and when circumstances demanded, or when the tramway tracks became worn out. Mr. R. H. Wikinson, city tramway manager, said the granting of the Provisional Order would not necessarily mean that all the tramway routes would automatically be converted to railless cars. Each route would be considered on its merits, and either the tramway would be reconstructed or railless cars or motor-buses substituted as experience dictated. The cost of reconstructing the tramway track would be £916,000, and of re-making the road after taking up the track and preparing for railless cars, £226,000. Mr. J. E. Lightburn, representing the County Council and several of the opposing Urban District Councils, said that if the order was granted a proviso should be inserted that the route to the depôt of the railless cars should be used only for getting to the depôts, and not as a vehicle route. The County Council submitted a proviso that the Corporation should not be relieved from offences in respect of overcrowding

in trolley vehicles. It also wished Sections 5 and 6 of the Town Police Clauses Act of 1890 relating to the control of public vehicles to apply to railless cars, that it should have a complete veto on poles on the highway, and that the Corporation should pave with granite the main roads at all the termini. It strongly objected to turning points at Stanningley and other places. The Ministry will give its decision in due course.

Continental.—Austria.—A new hydro-electric power station has recently been completed at Pinzgau for the supply of power to the Innsbruck-Salzburg section of the State railways. The plant utilises the upper falls in the Stubach valley, and has a capacity of 32,000 h.p., to be extended later to 48,000 h.p.

Poland.—It is reported that plans for the electrification of the railway between Warsaw and Radom are under consideration.

Hull.—Railless Cars.—At a recent meeting of the Corporation Tramways Committee the general manager drew attention to the recent increase in the cost of petrol, and suggested that the Committee should consider the question of introducing railless cars on certain routes in the city, which he was of opinion could be done at less cost. The Committee has visited Doncaster and Rotherham and inspected the system of railless cars in operation, and has decided that it is advisable to put this system of transport into operation on existing petrol-driven 'bus routes as far as it is deemed economically expedient. The general manager has been requested to furnish the Committee with a detailed estimate of the cost per mile of construction and operation.

Manchester.—Motor Omnibuses.—The Corporation Tramways Committee has decided to introduce a motor-omnibus service instead of tramcars to Wythenshawe, as it is considered that the laying of track to the new Corporation estate would be too costly. The cost of the proposed track was estimated at £75,000.

Railway Electrification.—The *Financial News* reports that the L.N.E.R and L.M.S. announce that work is being commenced this month on the erection of the overhead equipment in connection with the electrification of the Manchester South Junction and Altrincham line. Increased and accelerated train services will be provided when electric traction commences, representing a 50 per cent. increase in train mileage over the augmented steam service, or 80 per cent. over the steam service in 1927. Two new stations at Dane Road and at Navigation Crossing (North Altrincham) are to be constructed, and it is intended to open the Old Trafford Cricket Ground station permanently.

New Zealand.—Auckland.—The *Electrical Engineer of Australia and New Zealand* reports that, following on the recommendations of the Royal Commission which investigated street passenger transportation last year, a transport board has been formed to supervise and operate transportation facilities in the city and its suburbs. The chairman is Mr. J. A. C. Allum, who was previously chairman of the City Council's Tramways Committee, and the deputy chairman is Mr. G. Baildon, mayor of Auckland. The members represent various municipalities. The board took over the city council's tramway and motor-'bus undertakings on January 16th. It is considering plans for extensions of routes, and is reviewing the programme of works recommended by the tramway manager, Mr. A. E. Ford, last year, which involves an expenditure of £500,000. Mr. Ford recommends that 24 single-truck cars and six converted double-deck cars be replaced as early as possible with new rolling stock, and that 50 new tramcars be built. He states that about 10 miles of track is in need of reconstruction, but that otherwise the system is in good order.

Telegraph and Telephone Notes.

Canada.—Bell Telephone System.—According to a statement by Mr. C. F. Wise, president of the Bell Telephone Co. of Canada, made before the Railway Committee of the Canadian House of Commons in connection with the Bill before Parliament to authorise an increase in the capital stock of the company from $75,000,000 to $150,000,000, the company proposes to expend $126,239,000 during the next five years on extensions of its systems in the central provinces of Ontario and Quebec, where the company's lines are situated. The principal items, for some of which orders have already been placed, are as follows:—Montreal, $29,853,000; Toronto, $28,464,000; other cities and towns of more than 2,000 telephones, $30,539,000; places of less than 2,000 telephones, $12,003,000; toll lines and repeater equipment, $25,380,000. Extensions for 1929 alone will amount to $27,165,000; the chief items are: Montreal, $7,667,000; Toronto, $5,441,000; other cities and towns of more than 2,000 telephones, $6,973,000; places of less than 2,000 telephones, $2,190,000; toll lines and repeater equipment, $4,894,000. The Bell Company's Bill received the approval of the Railway Committee in amended form, the amendment, which was moved by the Minister of Railways and Canals, providing that the company shall not have the power to make any issue of stock without obtaining the approval of the Board of Railway Commissioners to the amount, terms, and disposition of the stock issue. The amendment applies only to the new stock of the company.

China.—Wireless Station.—A party of engineers left Lisbon on April 9th to establish a short-wave wireless-telegraph station at Macau, the Portuguese settlement in Southern China.—*Reuter* (Lisbon).

Germany.—Ship-shore Telephony.—At a meeting of representatives of Hamburg shipping companies it was stated that technical difficulties in the way of wireless telephone communication with ships at sea had been removed, but one of the obstacles in the way of fitting out all passenger vessels with the necessary telephone apparatus was the expense. Experiments are to be made with fishing vessels, and it is asserted that, as the telephone can be used by anybody, it will render superfluous the carrying of a wireless expert.

Greece.—Strike Threat.—The telegraph and telephone services were interrupted all over Greece on April 10th from 10 o'clock in the morning till 1 o'clock in the afternoon while the employés held meetings to discuss their grievances against the Government, which refused their application for increased wages. In the afternoon a meeting of employés in Athens passed a resolution asking the Government to satisfy their demands, and threatened that if their demands were not met the strike would not be limited to a few hours.—*Reuter* (Athens).

It was reported later that the dispute had been settled.

Guernsey.—Telephone Service.—The revenue statement and statistics for the year ended December 31st, 1928, of the Guernsey States Telephone Department (manager and engineer: Mr. E. H. Bennett) show a gross revenue of £19,219 and a net profit of £718. The number of lines increased by 172 to a total of 4,226, and the junction lines by 7 to 103. The mileage of overhead wire increased by 14 to 2,428 miles and underground circuits grew by 161 to 4,886 miles. The calls increased by 103,848 to a total of 2,607,855; trunk calls between the islands numbered 14,993. Telegrams and letters telephoned reached 26,371.

Hull.—Telephone Kiosks.—The manager of the municipal telephone system has reported to the Corporation Telephone Committee that the approximate cost of fitting multi-coin boxes in kiosks will be £15 per kiosk. He was asked to obtain information from other cities on the subject.

The Telephone Service.—An Emergency Device.—A scarlet disk is being placed in all multi-coin telephone boxes connected with manual exchanges whereby emergency calls will be speeded up. In the disk is a button which, on being pressed, operates a flashing signal in the exchange, and to this immediate priority will be given. The installation of the disks is due to complaints that delays have occurred through having to place coins in the slot to make connections in such cases of emergency as the calling of fire brigades and ambulances.

Radio Notes.

Receiving Licences.—Portable Sets.—The Postmaster-General draws attention to the following arrangements with regard to receiving licences:—

(1) A licence covers the use in the premises occupied by the licensee of any number of sets of receiving apparatus of any character by the householder, his family, and his domestic staff.

(2) A licence covers the temporary use (for example, during holidays) of receiving apparatus at another residence provided that no receiving apparatus is being worked at the home address.

(3) A separate licence is necessary for a separate building, such as a lodge or gardener's house, or for a portion of the same address under a separate tenancy.

In view of the increasing popularity of portable sets, the Postmaster-General has decided that in future a licence will cover, not only the use of sets at the address shown on the licence, but also the use of one portable set at any place in Great Britain and Northern Ireland by the licensee, or any member of his household. When a portable set is used away from the home address, the person using it must carry the licence with him and produce it if asked to do so by an authorised officer of the Post Office.

Licences.—European Progress.—The official returns for 1928, when compared with those for 1927, show generally a most gratifying state of affairs. The number of actual licence-holders in Europe (Russia not included) rose during 1928 from 5,897,000 to 7,163,000 says *World-Radio*, an increase of about 21.4 per cent., representing in persons, as distinct from homes, an increase of about five millions. The percentage increase is lower than in 1927, which is traceable to a slight slowing-up in the Swedish rate of increase and to a somewhat stationary state of affairs in Czecho-Slovakia, the Irish Free State, Italy,

and Norway. The new high-power stations projected for all these countries should bring them into line once again with the progress being made elsewhere.

Common Wavelength.—Stoke Station.—On April 11th the Stoke-on-Trent station of the B.B.C. was included among those transmitting on the national common wave-length of 288.5 metres.

Cuba.—Short-wave Agreement.—The Government of Cuba has formally notified the Canadian Government that it accepts the agreement concluded at Ottawa in January relative to the division of short radio waves in the North American area. All the countries represented at the January conference have now, according to *World-Radio*, formally accepted the agreement, which became effective on March 1st, 1929.

New Station.—A powerful wireless broadcasting station capable of direct communication with Europe and South America is being built at Tiscornia, across the bay from Havana. It is expected to be completed next month.—*Reuter* (Havana).

European Conference.—Wave-lengths.—A new plan for the repartition of wave-lengths among the broadcasting stations of Europe, to be known as the Plan of Prague, received the approval at Prague on April 13th of the official delegates of 27 European telegraph administrations, including those of Russia, and is to be put into operation on June 30th. A protocol accompanying the plan contains recommendations concerning the construction and operation of broadcasting and other wireless stations which are considered to be essential for the successful future of the broadcasting services, says *The Times*. To the Czecho-Slovak telegraph administration belongs the credit of having convoked this first official European conference on broadcasting. National sacrifices have been made with the common object of securing unanimity, and the British delegation, notably its chief, Mr. F. W. Phillips, assistant secretary of the General Post Office, who was chairman of one of the sub-commissions engaged upon the problem, made most valuable contributions to the success of the meeting, as did also General Ferrié and Ministerialrat Arendt, chief delegates of France and Germany, respectively. The Prague Plan is based on the work of the Union Internationale de Radiophonie and extends the principle of nine kilo-cycles separation between stations to all medium wave-lengths down to 216 metres.

Italy.—Short-wave Transmitter.—The Italian Broadcasting Company has authorised the Marconi Company to proceed with the manufacture of a short-wave broadcasting transmitter. It will to a large extent follow the design of 5SW, and will enable the Italian Broadcasting Company to carry on a service for the Italian colonies.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the Electrical Review containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—Melbourne.—May 15th. Victorian Railways. One geared 3-phase electric winding engine. (A.X. 7650.)*

May 15th. Melbourne Tramways Board. One 500-kW sub-station rectifier unit for automatic control, with switchgear. (B.X. 5206.)* Two rotary convertor units of 1,000 kW and one 500-kW for automatic control. (B.X. 5210.)*

June 4th. State Electricity Commission of Victoria. 22,000-V transformers and spares. (B.X. 5216.)*

June 18th. Posts and Telegraphs Department. Switchboard cable. (B.X. 5228.)*

Sydney.—May 13th. Public Works Department. One synchronous condenser. (B.X. 5205.)*

June 22nd. Transformers and spares for Burrinjuck hydro-electric development sub-stations. (B.X. 5230.)*

May 28th. Posts and Telegraphs Department. Telephone jacks and number plates. (B.X. 5202.)*

Carlisle.—Electricity Department. L.c. and l.c.a. paper-insulated cables for 12 months. (April 12th.)

Chertsey.—May 18th. Board of Guardians. Installation of electric lighting at the Institution at Ottershaw. (See this issue.)

Devizes.—May 1st. Rural District Council. Complete electrical installation for cottages situated in the parishes of Market Lavington, Potterne, and Rowde. Specifications and schedule from Mr. P. R. Trapp, clerk, Maryport Chambers, Devizes.

Dundee.—April 24th. Transport Department. Stores, including armature and field coils, castings, &c., for a year. Specifications, &c., from general manager.

April 27th. Harbour Trustees. Two 3-ton electric travelling jib cranes of portal type. Specifications, &c., from office of the General Manager and Engineer, Harbour Trust.

Dunfermline.—April 26th. Town Council. Electric lighting installation for housing scheme. Schedules, &c. (£1 1s. deposit) from Mr. D. H. Shaw, burgh engineer, City Chambers.

Edinburgh.—April 22nd. Education Authority. Electric lighting and heating installation at the new school at Saughton. Plans, &c., from Mr. J. A. Carfrae, architect, 3, Queen Street, Edinburgh.

May 6th. Installation of electric lighting at the Gorgie new special school and annexe to Trinity Academy. Schedules from the Education Offices.

Egypt.—Cairo.—May 15th. Ministry of Public Works. 120-kW d.c. Diesel-engine generating set and a small electrically-driven cooling water pump. Forms of tender from the Chief Inspecting Engineer, 41, Tothill Street, S.W.

May 25th. Prison Administration. Stores (including lamps and electrical articles). (C. 3022.)*

Epping.—May 2nd. Board of Guardians. Installation of electric light at the Institution, Epping. (April 12th.)

Glasgow.—April 22nd. Lighting Department. Materials, including electrical fittings and accessories, for one year. Specifications from office of department 20, Trongate.

Grimsby.—May 3rd. Electricity Department. 10 miles 33,000-V overhead line. (See this issue.)

India.—May 8th. Assam-Bengal Railway Co., Ltd. Turbo-generator set for Pahartali. (See this issue.)

Irish Free State.—Dublin.—April 29th. Electricity Supply Board. Supply and laying of 40,000-V cables in the County and City of Dublin. (April 5th.)

April 23rd. Dublin Port and Docks Board. Three electric overhead travelling cranes and gantries at new tobacco warehouse, Custom House Docks. Specifications from engineer to the Board, East Wall, Dublin.

London.—Central Electricity Board.—May 4th. Supply, delivery and erection of 33,000-V and lower-voltage cables in connection with the South-East England Electricity Scheme. (April 12th.)

April 29th. Central Scotland Electricity Scheme, 1927. Electricity meters. (March 15th.)

Islington.—May 6th. Cleansing Committee. Two new lead batteries for Edison electric vehicles. (April 5th.)

London County Council.—April 22nd. Reconstruction of conduit tramways in Whitechapel High Street. Specification (£5) from the Chief Engineer, Old County Hall, Spring Gardens, S.W.

H.M. Office of Works.—April 22nd. Supply of incandescent electric lamps. (April 12th.)

May 1st. Electrical accessories. (See this issue.)

Lourenço Marques.—April 22nd. Port and Railways Board. Electric hanging and ordinary lamps. (B.X. 5288.)*

Electric motors, &c. (A.X. 7765.)*

Manchester.—April 24th. Electricity Committee. Stores for 12 months, including dry batteries, conduit and wiring accessories, fuse boxes, auto-transformers, &c. Particulars from Mr. H. C. Lamb, Chief Engineer and Manager, Electricity Department, Town Hall.

May 3rd. Electricity Department. 12 months' supply of electric kettles, electricity meters, circuit breakers, star delta switch starters, a.c. motors, potential and current transformers, cables and time switches. (See this issue.)

April 30th. One 33,000-V, 11,500-kVA self-cooled outdoor auto-transformer, one 6,600-V switch, &c., and a neutral earthing resistance. (See this issue.)

Salford.—April 26th. Electricity Department. E.h.p. and l.p. paper-insulated lead-covered cable. Particulars from City Electrical Engineer, Electricity Department, Frederick Road.

South Africa.—Johannesburg.—May 16th. South African Railways and Harbours. Electric signalling apparatus. (B.X. 5165.)*

Cape Town.—May 1st. Electricity Department. 30-ft. steel tubular poles, cross arms, insulators, &c. (A.X. 7697.)*

Bloemfontein.—May 18th. Electric Supply Department. Turbine and generator, condensing plant and auxiliaries; switchgear and cables; cooling spray pond equipment, or alternatively cooling tower complete. (B.X. 5192.)*

Pretoria.—May 23rd. Posts and Telegraph Department. Rubber-covered wire and telephone cables. (B.X. 5229.)*
May 30th. Telegraph materials, &c. (A.X. 7767.)

Southampton.—April 30th. Electricity Department. Steel-framed building, steelwork for firing floor, platform carrying induced draught fans, overhead bunkers, &c.; two water-tube boilers with superheaters, economisers, air heaters, mountings, chain-grate stokers, water walls, induced and forced draught fans, sootblowers, steel flues and chimneys, grit arrestors and collectors, &c.; steam, feed-water and other piping, covering, &c.; water softener. (March 29th.)

Stafford.—April 30th. County Education Committee. Installation of electric lighting and power at the New High School for Girls, Wellington Road, Bilston. Installation of electric light at the Girls' High School, Stafford. (April 12th.)

Uruguay. — Montevideo. — May 6th. State Electricity Works. Electric cables and accessories. (B.X. 5178.)*

Walthamstow.—May 3rd. Education Committee. Electrical installation for the Billet Road school. (April 12th.)
May 8th. Electricity Department. L.p. distributor and service cables; e.h.p. and l.p. feeder cables. (See this issue.)

Wolverhampton.—May 10th. West Midlands Joint Electricity Authority. One 50,000-kW turbo-alternator with step-up transformers, &c., condensing plant, boiler feed pumps, evaporators, circulating water pumps, &c., main and auxiliary 33,000-V switchgear with circuit breaker. (March 29th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Belfast.—City Electricity Department.
Twelve months' supply of electric lamps.—Siemens Electric Lamps & Supplies, Ltd.

Bradford.—Tramways Committee. Accepted :—
Equipment of railless vehicles under construction with air brakes (£1,583); six double-deck railless electric trolley vehicles and certain spare parts (£12,769); and one single-deck demonstration railless vehicle (£990).—English Electric Co., Ltd.
Electricity Committee. Recommended :—
Circulating water valves and atmospheric exhaust valve for turbo-alternator; and steam valves for boiler and high-pressure plant.—J. Blakeborough & Sons, Ltd.
Reinforced steelwork for new cooling pond at Valley Road power station.—Indented Bar & Concrete Engineering Co., Ltd.
Two feed pumps for Valley Road power station.—Mather and Platt, Ltd.

Burton-on-Trent.—Town Hall Committee. Accepted :—
Electric organ-blowing installation at Town Hall (£96).—A. Talbot.

Chesterfield.—Electricity Committee. Accepted :—
New overhead feeders to supply the New Whittington trolley 'bus extension (£661).—Macintosh Cable Co., Ltd.
Miscellaneous cables (£683).—Greenwich Cable Works, Ltd.

Douglas (I. of M.).—Electricity Committee. Accepted :—
High-pressure panel at Tromode Road sub-station (£96).—New Switchgear Construction Co., Ltd.

East Ham.—Electricity Committee. Recommended :—
L.p. switchgear (£209).—Bertram Thomas.
H.p. switchgear (£1,438) (revised quotation).—A. Reyrolle and Co.

Gravesend.—Electricity Committee. Accepted :—
Overhead lines (£1,273).—W. T. Henley's Telegraph Works Co., Ltd.
Internal telephone installation at offices (£94).—Dictograph Telephones, Ltd.

Hastings.—Town Council. Accepted :—
Electrically-driven pumping plant for the Kent Street water well (£2,000).—Mirrlees Watson Co., Ltd.

Hull.—Telephones Committee. Recommended :—
Cable (£279).—Siemens-Schuckert (Great Britain), Ltd.
Electricity Committee. Accepted :—
Circulating water pump (£3,363).—Drysdale & Co., Ltd.
Three 1,500-kW motor convertors :—

Ateliers de Constructions Electriques de Charleroi	£10,500
Crompton Parkinson, Ltd.	10,650
Metropolitan-Vickers Electrical Co., Ltd.	13,115
British Thomson-Houston Co., Ltd.	13,115
Bruce Peebles & Co., Ltd. (Accepted.)	13,115
English Electric Co., Ltd.	13,115
Mather & Platt, Ltd.	13,116
Brush Electrical Engineering Co., Ltd.	13,620
Hewittic Electric Co., Ltd.	19,719

Holbeach.—Board of Guardians. Accepted :—
Installing electricity at the Institution (£138).—Bratley and Sons.

Leeds.—Baths Committee. Accepted :—
Electric light fittings for 12 months.—Sun Electrical Co., Ltd., and G. Casperson.
Health Committee. Accepted :—
Electric light installation at Gateforth Sanatorium (£103).—Squires & Sons, Ltd.
Electricity Committee. Accepted :—
Meters for 12 months (about 2,500) (schedule prices).—Measurement, Ltd.
Four 1,000-kVA transformers (£777 per set; additional transformers for a period of two years at special terms).—British Electric Transformer Co., Ltd.
Three 10,500-kVA transformers, spare transformer, &c. (£11,680).—Hackbridge Electric Construction Co., Ltd.
Cables (£1,194).—W. T. Henley's Telegraph Works Co., Ltd. (£2,565).—Enfield Cable Works, Ltd.; and (£3,110).—Macintosh Cable Co., Ltd.
Tramways Committee. Accepted :—
1,250 tons tram rails (£9 10s. 3d. per ton); fishplates (£13 10s. 3d. per ton).—Cargo Fleet Iron Co., Ltd.
Lay-outs, points, crossings, &c.—(£3,355), Edgar Allen and Co.; (£1,058), Hadfields, Ltd.; and (£1,039), Titan Trackwork Co., Ltd.
500 tram tires (£24 per ton).—Monkbridge Iron & Steel Co., Ltd.
Electrodes.—Premier Electric Welding Co., Ltd.

Liverpool.—Watch Committee.
Five additional telephone boxes (£105).—Standard Telephones & Cables, Ltd. (Recommended.)
Electrically-driven pumping machinery for Aubrey Street Station (£2,840).—M ther & Platt, Ltd. (Accepted.)

London.—
Electric wiring contract for the new Bank of England.—Drake & Gorham, Ltd.

Luton.—Town Council. Accepted :—
Steel construction work (£10,960).—Braithwaite & Co.
Travelling crane (£1,530).—Herbert Morris, Ltd.
Coal tipper, elevator, and conveyor (£4,550).—Henry Lees.

Malvern.—Urban Council. Accepted :—
1,000 yd. of h.p. concentric cable, approx. (£550).—Pirelli-General Cable Works, Ltd.

Manchester.—Waterworks Committee. Accepted :—
Additional converting and pumping plant for Lostock booster station.
Transformer.—Metropolitan-Vickers Electrical Co., Ltd.
A.c. and d.c. switchgear.—Ferguson, Pailin, Ltd.
D.c. circuit breakers and field regulator.—Whipp & Bourne, Ltd.
C.i. pipes.—Sheepbridge Coal & Iron Co., Ltd.
Valves.—Glenfield & Kennedy, Ltd.
Motor starting and control gear.—Brookhirst Switchgear, Ltd.
Tramways Committee. Accepted :—
Maximum traction trucks.—Electro-Mechanical Brake Co., Ltd.
5-cwt. pneumatic power hammer with motor and starter.—B. & S. Massey, Ltd.
Shearing machine with motor and starter.—Scott Bros. (Halifax), Ltd.
Electricity Committee. Accepted :—
Conversion of automatic rotary convertor plant.—Harland Engineering Co., Ltd.
Tramways Committee. Accepted :—
Supplies for 12 months :—
Grid resistances.—Rheostatic Co., Ltd.
Ampere-hour meters.—Chamberlain & Hookham, Ltd.
Cables.—St. Helens Cable & Rubber Co., Ltd.
Galvanised mild steel wire cable.—Rd. Johnson and Nephew, Ltd.
Controller spares.—British Thomson-Houston Co., Ltd.; English Electric Co., Ltd.
Electro-mechanical brake spares, &c.—Metropolitan-Vickers Electrical Co., Ltd.
Controller fingers, &c.—Fairless Engineering Supplies Co., Ltd.; Forest City Electric Co., Ltd.

Northern Ireland.—Belfast.—County Borough Education Committee. Accepted :—
Electric lighting installation at the Riddel Memorial P.E. School (£128).—G. McCartney.
—*Irish Builder and Engineer.*

Plymouth.—Electricity Committee. Recommended :—
Switchgear.—A. Reyrolle & Co.
Cables.—British Insulated Cables, Ltd., and Metropolitan Electric Cable and Construction Co., Ltd.
Meters (a.c. and d.c.).—Ferranti, Ltd.
Transformers.—British Electric Transformer Co., Ltd.

Torquay.—Electricity Committee. Accepted :—
Switchgear (£431).—British Thomson-Houston Co., Ltd

Watford.—Electricity Committee.
House wiring for 12 months (schedule rates).—J. W. Russell. (Recommended.)
Cable.—W. T. Henley's Telegraph Works Co., Ltd. (Accepted.)

Weymouth.—Electricity Committee. Accepted:—
Earthing equipment for one 1,500-kW and one 3,500-kW turbo-alternators (£325).—English Electric Co., Ltd.
One 50-amp. rotating standard meter-testing set (£90).—Ferranti, Ltd.
E.h.p. and l.p. equipment for supply to Weymouth Bay estate (£1,643).—Johnson & Phillips, Ltd.

Forthcoming Events.

Physical Society.—Friday, April 19th. Imperial College of Science, South Kensington, S.W. 5 p.m. Guthrie Lecture. "The Properties of the Elements under High Pressure." Prof. P. W. Bridgman.

Institution of Municipal and County Engineers (Southern District).—Saturday, April 20th Council House, Corn Street, Bristol. 10.30 a.m. "Description of the New Power Station, Portishead." Mr. H. Faraday Proctor.

Association of Mining Electrical Engineers.—Saturday, April 20th. South Wales Institute of Engineers, Park Place, Cardiff. 6 p.m. "Three-phase Induction Motors and their Control Systems." Mr. H. T. Gregory.

Electrical Power Engineers' Association (London Local Technical Group).—Tuesday, April 23rd. Victoria Mansions Restaurant, Victoria Street, S.W. 7.15 p.m. General meeting of Group members, interspersed with social items.

Institution of Civil Engineers.—Tuesday, April 23rd. Institution, Great George Street, S.W. 6 p.m. "The Arapuni (New Zealand) Hydro-Electric Development." Mr. F. W. A. Handman. "The Tata Power Co.'s Hydro-Electric Project." Mr. N. J. M. Cursetjee.

Chadwick Public Lecture, 1929.—Tuesday, April 23rd. Institution of Mechanical Engineers, Storey's Gate, S.W. 8 p.m. "What Health and Civilisation Owe to Engineering." Mr. C. E. Stromeyer.

Royal Society of Arts.—Wednesday, April 24th. John Street, Adelphi, W.C.2. 8 p.m. "The Educational Value of Broadcasting," by Mr. H. L. Fletcher.

Overhead Lines Association.—Wednesday, April 24th. Institution of Electrical Engineers, Savoy Place, W.C. 5.30 p.m. "Practical Uses and Tests of Concrete Poles in the U.S.A." Mr. W. Fennell.

Institution of Electrical Engineers.—Thursday, April 25th. Institution, Savoy Place, W.C.2. 6 p.m. Twentieth Kelvin Lecture. "Lightning." Dr. G. C. Simpson, F.R.S.

(Scottish Centre).—Friday, April 26th. Technical College, Dundee. 7.30 p.m. "Load Levelling Relays and their Application in Connection with Future Metering Problems." Mr. W. Holmes. "The Lothian Protective Gear for Distribution." Mr. H. C. Babb.
Saturday, April 27th. Excursion from Dundee to Elie by road.

(South Midland Students' Section).—Tuesday, April 23rd. Joint meeting with the Rugby Engineering Society.

(London Students' Section).—Friday, April 26th. Institution, Savoy Place. 6.15 p.m. Annual general meeting. "The Manufacture and Testing of Submarine Cables." Mr. V. E. Connor.

Chemical Society.—Thursday, April 25th. Burlington House, W. 5.30 p.m. "T. W. Richards" Memorial Lecture by Sir Harold Hartley, F.R.S.

Birmingham Electric Club.—Friday, April 26th. Grand Hotel. 7 p.m. "Electric Cables—Installation and Maintenance." Mr. H. Blades.

The "Electrical Review" Service Department.

Inquiries must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

Red Light lighting sets (spare parts required).

Notes.

Institution of Engineers-in-Charge.

About 250 members and guests enjoyed the 29th annual dinner of the Institution of Engineers-in-Charge at the Holborn Restaurant on April 12th. Mr. H. G. Burford, president of the Institution, took the chair. After the loyal toasts, Sir Brodie H. Henderson, K.C.M.G., president of the Institution of Civil Engineers, proposed "The Institution." His Institution and that of the Engineers-in-Charge worked in the belief that theory was no good without practice, and he thought that before long all the leading Institutions would adopt that policy. The entrance examinations to Institutions were getting more and more difficult; he was not sure that that was altogether a good thing. The time had come when engineers could not be strictly divided into sections; they could only exist by co-operation. The more practical knowledge the designer had the greater was the simplicity of his designs, and the engineer's ideal should be simplicity. He congratulated the "Engineers-in-Charge" on their membership (between 500 and 600); to seat half their members at the annual dinner indicated the vitality of the Institution. In addition to spreading knowledge, an important function of the engineering organisations was to promote good fellowship, which led to efficiency. The Institution of Engineers-in-Charge was one of the most useful in the engineering profession—its papers were of a high standard, and the discussions were excellent. When the membership was scattered it paid to keep up a high standard of literature; in the "Civils" the members abroad were just as keen as those at home, for that reason.

In his reply, Mr. Burford said that the engineering Institutions should put before the public the serious national question of the great shortage of skilled labour, and he suggested that a conference of the leading Institutions might be held to consider ways and means of doing so. There was no incentive nowadays for young people to enter the skilled trades. If the great Institutions took the lead they would get Parliamentary and national support. The success of this country had been built up on the work of its skilled men. Lord Eustace Percy was very keen on the question, and with the support of the great Institutions he would be able to do a great deal.

Mr. J. Wardlaw Milne, M.P., proposed "Transport and Industry." He said that the immense impetus given to communications in recent years would probably result in the peace of the world, in addition to ensuring the safety of the world's supplies. He emphasised the need for vision with regard to transport. One of the difficulties of the trained man was that he saw little in the future; the remedy was not to reduce the wages of the sheltered trades, but to level up the others. To do this co-operation between the great industries was necessary. In spite of the shortage of skilled labour, there was never a time when there was a better nucleus of engineers in this country.

Dr. W. R. Ormandy, F.I.C., in reply, speaking of the fuel of the future, said that the time of oil had come, and oil was going to remain. There was no doubt that a great German concern had succeeded in producing oil from brown coal commercially. He had every reason to believe that the day was not far distant when English coal would be the source of fuel for automobiles, &c., so keeping a great amount of money in this country. He had recently visited Jugo-Slavia, where there was vast wealth in minerals, &c., lying idle because of lack of transport; he had reason to believe that the dormant areas would soon be developed and that the work would be given to this country.

Mr. G. A. Hughes, vice-chairman of the Institution, warmly welcomed the visitors, on whose behalf Mr. J. Roger Preston, president of the Institution of Heating and Ventilating Engineers, replied.

Mr. S. Carter, chairman of the "Engineers-in-Charge," proposed "Our President," and Mr. Burford suitably replied.

Electrical Association for Women.

Following upon the Council meeting and general meeting of members, the luncheon of the Electrical Association for Women took place at the Hotel Cecil on Tuesday last and was well attended by members from all parts of the country. The gathering included distinguished representatives of almost every branch of the industry. Mrs. Wilfrid Ashley, president of the Association, being in the chair. The speeches were opened by Sir John Snell, Chairman of the Electricity Commission, his subject being "The Economy of Electricity." In the course of his address he gave particular instances of the use of electricity, one case being that of an eight-roomed house occupied by six persons for whom the consumption per head over a three-years' average had been 1,324 units, the total cost being 0.88d. per unit. He suggested that his original estimate made in 1926 of 500 units per head at the end of some ten years might need very considerable modification in the light of the facts brought forward. He wished and expected to see electricity brought to all outlying districts, particularly those in which no gas was available, as he appreciated that for some time to come there would be considerable competition with the gas interests in districts where gas was already firmly established. Electricity in outlying districts, however, meant very considerable outlay, and such expenditure

would not be repaid unless an extensive scheme of education in the use of electricity could be adopted widespread. He felt that the Electrical Association for Women could and would do extraordinarily good work in such directions.

Lady Emmott, J.P., president of the National Council of Women of Great Britain, in reply, said that women had feared, and still feaeed, that electricity was extremely costly, but she felt sure from what Sir John Snell had said that that fear would be speedily overcome. Electricity would obviously play an extremely important part in improving the health of the movement to spread the gospel of electricity abroad.

Lt.-Col. K. Edgcumbe, president of the Institution of Electrical Engineers, proposed the toast of the "Electrical Association for Women." He opened in his best humorous vein and, turning to the work of the Association, said that everything done by it was for the benefit, not only of its members, but for the country as a whole. He believed that the best way to reduce costs would be to increase the intensity of demand, and he hoped that all members would induce their friends to use electricity on every possible occasion, and also to see that their appliances were made by British manufacturers. He pointed out the fact, which is not always appreciated, that electricity is now cheaper than it was in 1914, whereas gas is some 50 per cent. dearer and coal about twice as costly as it was before the war.

Mrs. Wilfrid Ashley, replying, said that the E.A.W. was one of the surest direction-posts towards progress. It was for women to create the demand for electricity and, no doubt, the Central Board would see that adequate steps were taken to cope with the demand so created.

After the luncheon members of the Association visited the works of M.K. Electric, Ltd. The various processes in the manufacture of M.K. products having been inspected, the party was taken to Messrs. Belling & Co.'s factory at Enfield, and, after being entertained to tea, they were shown round the works.

Mr. Belling welcomed the members of the Association, and gave a brief *résumé* of the development of both M.K. Electric, Ltd., and Belling & Co. The latter, he said, commenced in 1912 at Enfield on a very small scale indeed. After a year, the works were moved to larger premises, about eight times the size, at Edmonton, and in the next two years the size of that factory was doubled. The present factory at Enfield was built four years ago, and is claimed to be probably the largest in the world devoted exclusively to the manufacture of electric fires, cookers, and water heaters. There are 24 bays, each 200 ft. by 20 ft.

Miss C. Haslett briefly replied, and the party, which numbered 150, left the works about 6 p.m. for London in motor coaches provided by Belling & Co.

The Association Ball followed at the Hotel Cecil, Mrs. Wilfrid Ashley receiving the guests at 9 p.m.

On March 20th members of the Birmingham and Midlands branch of the Association visited the works of the Electric Construction Co., Ltd., at Wolverhampton. On March 25th over 50 members of the same branch visited the printing works of Messrs. Kenrisk & Jefferson in West Bromwich.

On April 11th members of the Birmingham and Midlands Branch of the Association paid a visit to the Birchills power station.

The first meeting of the Bristol and District Branch of the Association was held on April 11th, and took the form of a lantern lectnre by Mr. G. S. Francis, of the British Electrical Development Association. The lecture dealt with modern architecture, and the important part played by electricity in its development.

Appointments Vacant.

Probationary assistant, telegraph engineers, for the Government of Nigeria. Technical officer (£361) for the Air Ministry. Junior assistant engineer (£200) for the Newport Corporation Electricity Department. Chief operation engineer (£1,200) for the River Shannon hydro-electric development. Lecturer in engineering for the Widnes Municipal Technical College. (See our advertisement pages to-day.)

Transient Voltages.

When subject to transient voltage excitation, local concentration of voltage takes place in an ordinary transformer in which the capacitance charging current of the coils to ground is supplied through the winding, or the ratio of inductance and capacitance of the various parts throughout the winding is not constant. In a recent paper, Mr. K. K. Palueff, of the American General Electric Company, explained various calculations and tests of voltage distribution in the winding, caused by the impact of (*a*) damped high-frequency oscillations, and (*b*) unidirectional-travelling waves. Transformers having one terminal grounded, such as are used in three-phase star connection, particularly in high-voltage systems, are frequently built with the insulation graded to other windings and ground, in the order of the normal frequency voltage stress. The danger of such practice is shown in power transformers which are subject to transient over-voltage, since voltage oscillation in the winding may raise the voltage to ground of intermediate points above the terminal voltage, unless the design of the winding eliminates oscillation. According to the theoretical and experimental data given in his paper, the distribution and magnitude of voltage stresses existing during recognised standard insulation tests are essentially different from the stresses created by transient voltages. This permits the construction of transformers that would satisfactorily pass standard insulation tests, but at the same time would not be suitable for average service. Mr. Palueff described a new type of "non-resonating" transformer for use on grounded-neutral systems, in which type voltages at all frequencies distribute uniformly along the windings, as the possibility of internal voltage resonance is eliminated by a proper balance of distributed capacitance and inductance of the winding. This is accomplished principally by means of conducting surfaces (shields) placed outside the winding and connected to its line terminal. The action of the shields is similar to that of the shielding ring on an insulator string. It neutralises the effect of the capacitance current from the inside surface of the winding to ground, by supplying to every point of the winding a "charging current" equal to the "discharging current" of that point to ground. The application of the shield in some cases reduces the local stresses to one-eightieth. Up to the present time the total capacity of the new type of transformer exceeds half-a-million kVA.

Iron Losses in Turbo-generators.

This subject was recently dealt with in a paper read by Messrs. C. M. Laffoon and J. F. Calvert at a regional meeting of the American Institute of Electrical Engineers. There is no convenient method for determining the iron losses in large machines under load, and the authors outlined analytically the factors influencing the change of iron loss under load. While very definite results can be obtained for a simplified machine, it is not recommended at present that any change be made in the A.I.E.E. Standards for computing load loss, because there is much to be done before the work can be considered complete. This particular problem is typical of many which are entirely suitable for purely analytical study, and should furnish very desirable work for investigators who do not have access to large machines for extensive tests, but who desire to carry on studies relating to this type of apparatus. This, as well as similar loss problems, can be studied much more readily by theoretical work and model tests than by measuring the total losses of an entire machine, because the value sought is never a predominant proportion of the total value measured; even if satisfactory results be obtained on a particular machine, they are not generally applicable to all such apparatus. The authors demonstrated that on the basis of flux distributions the machines can be most conveniently divided into end zones, which present three dimensional problems, and a large central zone, which presents only two dimensional problems. The losses in each part were discussed qualitatively, and those in the central zone were obtained quantitatively for an ideal machine in which only the fundamentals of the flux waves are present. It was shown that, contrary to the usual view, these losses do not vary as the square of the generated voltage, but are predominantly affected by the ratio of the slot to total leakage reactance. The results were shown by curves, and the complications in the problem introduced by the usual commercial designs by non-sinusoidal field forms, phase bands, &c., were discussed qualitatively.

Noises in Electrical Apparatus.

In a study of noises in electrical apparatus, such as motors, generators, vacuum sweepers, induction regulators, gears, and radio loud-speakers, Messrs. T. Spooner and J. P. Foltz, of the Westinghouse Electrical and Manufacturing Co., have found the quantitative determination of noise to be very difficult, even with an analyser, owing to nodes and sound reflections. Noise often varies very greatly in different situations around a piece of apparatus, and it varies with the position of the objects in the room. For the accurate study of noise, the apparatus should be located in a sound-proof room with deadened walls, so that there will be little reflection. However, in a large number of instances when only one or two frequency components are important, qualitative results are quite sufficient. In other cases when tests must be made under shop conditions only, qualitative results can be obtained owing to a large amount of reflection as well as interference from the shop noises. In these cases results can be obtained very quickly by means of an analyser by using headphones in place of the meter usually employed to measure amplitude. Then, even though the surrounding noise level is very high, it is possible to obtain accurate frequency determinations of the noise being studied. Usually, if the frequencies of the principal components can be determined, the cause, or causes, of the noise can be assigned and means taken to eliminate, or reduce, it. Therefore a qualitative test is very often sufficient to enable the designer to avoid similar conditions in future apparatus.

Conservation of Wooden Poles.

Wooden poles are largely used in France for carrying electrical conductors, especially in connection with distribution systems in agricultural areas. At a recent meeting of the French Syndicat des Producteurs et Distributeurs d'Electricité, Mr. Dronin and Mr. Medan, of the Compagnie Générale d'Electricité, read a paper in which they dealt with the difficulties encountered with such supports, and with means of extending their useful life. The authors stated that in practice it was found, when wooden poles broke, that the fracture usually

occurred at the ground level. In their opinion it was necessary to provide a coefficient of safety double that sufficient for indestructible masts. There were several methods of conserving wooden masts, such as treating them with sulphate of iron or copper, or with bichloride of mercury or zinc, creosote, &c., this being done either by immersion, injection, or the combined action of vacuum and pressure. The authors considered it specially necessary to protect the lower ends of wooden poles by embedding them in ferro-concrete. In recent years a movement had set in towards dispensing with the fixing of poles in the ground and of mounting them in steel or ferro-concrete sockets standing in and above the ground; a number of arrangements of this kind were described in the paper. The authors were in favour of the socket plan, and estimated that a well-injected wooden pole mounted in a socket should last for thirty years, at the end of which time, as the sockets were indestructible, it would only be necessary to put in a new pole.

Summer Time.

Summer time will be substituted for Greenwich mean time throughout Great Britain at 3 a.m. on April 21st. Accordingly all timepieces should be advanced by one hour during the night of Saturday-Sunday next.

I.E.E. Benevolent Fund Golf Competition.

The second annual golf tournament in aid of the Institution of Electrical Engineers benevolent fund and for the trophy presented by Messrs. W. L. Winning and Andrew Hutchison, will be held this summer on the various courses within the Scottish Centre. The competition will be open to members of all classes, and all members of the Institution should subscribe, whether players or non-players, in view of the object for which the competition is being promoted. The competition, in the first place, will be divided into districts, and the following have consented to undertake the duties of local secretaries:—Glasgow: Harold W. Bewsher, 147, St. Vincent Street, Glasgow, C.2. Edinburgh: J. Johnstone Foggo, 37, St. Patrick Square, Edinburgh. Dundee: P. Philip, Corporation Electricity Department, Dudhope Crescent Road, Dundee Aberdeen: J. Alex. Bell, Corporation Electricity Department, Millburn Street, Aberdeen. The entrance fee will be 2s. 6d.

Electrically-welded Ships.

The Treaty of Versailles allows Germany to replace obsolete vessels among her existing battleships, but the displacement of the craft she may build is limited to 10,000 tons. It is proposed to build four warships to comply with those conditions, their construction to be spread over a number of years, and by the use of "supergrade" light steel and electric welding, instead of riveting, it is hoped to save 550 tons in weight each. The speed of the ships will be from 26 to 28 knots, and the engines will be of the Diesel type, of very light weight.

B.S.S. for Photometric Integrators.

The British Engineering Standards Association has just issued B.S.S. No. 354-1929 for photometric integrators. The specification deals with photometric integrators of either spherical or cubical shape. The integrator may be used for the measurement of the light output of tungsten-filament electric lamps, or for ascertaining the efficiency of translucent or dispersive reflector fittings, particulars for these fittings being dealt with in B.S.S. Nos. 324 and 232, respectively. The specification gives the necessary constructional details for integrators of 24 inches and upwards in size, and it defines the requirements for the interior coating. Copies of the publication may be obtained from the British Engineering Standards Association, Publications Department, 28, Victoria Street, S.W.1, price 2s. 2d. post free.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

The most cordial good wishes of the Electrical Review and a host of other friends are offered to Mrs. Annie Mole and her husband on the celebration to-day of their golden wedding. Mrs. Mole, who is known in many parts of the country as one of the pioneers of electric cooking, the advantages of which she has been demonstrating for 25 years, wrote an interesting article on the subject in our last "Domestic Electrification Number" (October 19th, 1928, p. 650).

The Hull Corporation Electricity Committee has appointed Mr. G. A. Vowles as personal engineering assistant, at £569 per annum.

Mr. John Herbert Greenwood, of the Rotherham staff of the Yorkshire Electric Power Co., Ltd., who was married on March 30th to Miss J. U. Patrick, has been presented by his colleagues with a set of carvers.

Mr. J. Reed Wilkinson, B.Sc. Tech., A.M.I.E.E., has been appointed chief sales engineer and manager of the London office of Messrs. Ferguson, Pailin, Ltd., Bush House, London, W.C.2, in succession to the late Mr. Frank Thorp. Mr. Wilkinson has had many years' experience in the various departments of the company's head office, and for the last three years has been chief of the company's sales and estimating departments at the head office.

We reproduce herewith a photograph of Mr. S. E. Fedden, who, as we announced last week, has been appointed by the Central Electricity Board to the position of district engineer for the Mid-East England Electricity Scheme. Mr. Fedden was educated at Repton School, and received his early electrical training at the School of Electrical Engineering, London, and with the General Electrical Co., Schenectady, U.S.A. He also acquired knowledge of mechanical engineering with Messrs. Robey & Co., Lincoln. After further experience in Canada and the United States, he returned to England, and was appointed by the late Sir Alexander Kennedy to a position with the Westminster Electric Supply Corporation, ultimately becoming chief assistant engineer at the Davis Street station. He then went to the Edinburgh Corporation Electricity Department, where he was successively distributing engineer and chief assistant engineer. Later he was appointed consulting and chief engineer to the Burgh of Greenock and a number of electrical undertakings, including that of the Burgh of Broughty Ferry. Mr. Fedden's long association with Sheffield as chief engineer and manager of the Corporation Electricity Department dates from June, 1900, and he has been responsible for the undertaking during its tremendous growth over that period. In 1900 the plant capacity was 2,325 kW, the sales amounted to 1.3 million kWh, the number of consumers was 967, the capital expenditure £340,406, and the gross revenue £23,342. The figures for the year ended March 31st last were: Plant capacity, 106,000 kW; energy sold, 198.2 million kWh; number of consumers, 47,521; capital expended, £4,649,740; and gross revenue, £931,472. Mr. Fedden is a member of the three leading engineering institutions, and was president of the I.M.E.A. in 1907. He enters upon his new duties on May 1st.

Mr. S. E. Fedden, M.Inst.C.E., M.I.E.E., M.I.Mech.E.

Who has been appointed District Engineer for the Mid-East England Electricity Scheme.

Mr. J. A. Bell, city electrical engineer, Aberdeen, has been granted a honorarium of £500 by the Electricity Committee for his special services for the past six or seven years during the extension of the undertaking. There was a counter-suggestion that the "recognition" should take the form of an increase in salary, but the honorarium was eventually approved.

Mr. Chas. P. Bramley, late works manager and director of the Lancashire Dynamo and Motor Company, Trafford Park, has joined the staff of the Igranic Electric Co. in the capacity of works manager at Bedford.

The Department of Overseas Trade announces that Mr. E. H. Mulock, lately Commercial Secretary for Egypt, has been appointed Commercial Secretary at Budapest in succession to Mr. H. N. Sturrock.

Mr. D. L. Thornton, M.A., has been appointed editor of the *Mechanical World and Engineering Record* in succession to Mr. C. N. Pickworth, Wh.Sch., who, as recently announced, retired last month after occupying the editorial chair for 40 years.

The Earl of Midleton has been elected chairman of the Globe Telegraph and Trust Co., Ltd. Mr. F. A. Johnston has joined the board to fill the vacancy created by the death of Sir John Denison-Pender.

Mr. Robert Lee, whose portrait is reproduced herewith, was recently appointed borough electrical engineer of Stockport at a commencing salary of £1,000 per annum. He was for many years assistant electrical engineer to the undertaking, but left Stockport about a year ago to take up the post of electrical engineer to the St. Helens Corporation. Sixty-two applications for the appointment were received by the Stockport Council, and at the meeting at which Mr. Lee's appointment was approved a letter was received from the Associated Municipal Electrical Engineers pointing out that the salary offered was below the minimum under the Association's scale and asking the Council to consider increasing it. It was resolved that the letter should "lie on the table."

Lafayette] [*Manchester.*

Mr. R. Lee, A.M.I.E.E.

The new Borough Electrical Engineer of Stockport.

Mr. B. S. Sarbutt, Carron Company's London representative, has resigned, and is about to take up a post on the staff of the British Electric Transformer Co., Ltd. He will represent it in the Southern counties for "Sunray Tricity" apparatus.

Mr. Henry Nimmo, M.I.E.E., M.I.M.E., electrical adviser and superintending electrical engineer to the Government of Burma, has proceeded on eight months' leave, and Mr. J. H. Eades is officiating in that post. Mr. Nimmo hopes to visit a number of electrical works, power stations, &c., during his stay in Great Britain and on the Continent. His address while in England will be: Wingates, Matching Green, Harlow, Essex.

In a note in our last issue we described Mr. J. A. Robertson as consulting engineer to the Salford Corporation. We find that we should have qualified this by adding that it was for the construction of the Agecroft power station as all extensions to the undertaking, including one of 20,000 kW at present in hand, are now carried out under the direction of Mr. L. Romero, the borough electrical engineer.

Mr. R. Vine Hall has been appointed assistant chief engineer of the Sydney Municipal Electricity Undertaking, at £1,500 per annum, says the *Australian Electrical Times*.

M. Voislav M. Popovitch has been appointed Director-General of the Jugo-Slavian Posts and Telegraphs in succession to M. M. Georgevitch, who has lately retired.

Mr. P. J. Underwood, of the staff of the West Midland Joint Electricity Authority at Wolverhampton, who was married on April 4th to Miss Elsie A. Mantle, was presented by the office staff with a canteen of cutlery.

The Southport Town Council has increased the salary of Mr. J. J. Young, station superintendent at the electricity works, from £468 to £510 per annum.

Obituary.—Mr. V. A. Fynn.—Our American contemporary, the *Electrical World*, announces the death, which occurred at St. Louis, Mo., on March 20th, at the age of 58 years, of Mr. Valère A. Fynn, who, until twenty years ago, was a well-known electrical engineer and inventor in this country. He was born in Russia, but his father was an Irishman. After receiving his technical education at the Swiss Federal Polytechnic in Zurich, he gained practical engineering experience with Brown, Boveri & Co., in Switzerland, and with Easton, Anderson & Goolden in London. In London he was in practice as a consulting engineer. He was the inventor of a single-phase motor, and these were manufactured by the Alioth Company in various European companies, and by the General Electric Co., Ltd., in England. Our contemporary states that it was in 1909 that Mr. Fynn transferred his interests to the United States, and from that year until 1921 he was retained by the Wagner Electric Manufacturing Company as consulting engineer. The Wagner Electric took out licences under almost all of his numerous patents, and during the twelve years this connection lasted Mr. Fynn gave his undivided attention to it. Since 1921 he has engaged in independent consulting engineering work with offices in St. Louis. Mr. Fynn was a Fellow of the American Institute of Electrical Engineers and a member of the Institution of Electrical Engineers.

Mr. W. Worby Beaumont.—We have to record with regret the death of Mr. William Worby Beaumont, M.Inst.C.E., M.I.E.E., M.I.M.E., the well-known consulting engineer and pioneering authority on motor traction of all kinds. He was the author of many publications on road vehicles, including industrial electric vehicles and trucks, electric motor boats and motor-cars, and on various other subjects, including rail corrugations, gas traction, &c. For some ten years he was joint editor of the *Engineer*, from which activity he returned to consulting engineering work. He was a member of the Advisory Committee of the Ministry of Transport. He was an enthusiast on road-making, and we well remember some of his speeches at British Association meetings between twenty and thirty years ago, in which he stressed the urgency of the expenditure of many millions upon the improvement of existing roads of Britain and the construction of many new ones.

Mr. C. E. Crocker.—The *Industrial Australian* reports the death, in March, as the result of an accident, of Mr. Claude Edward Crocker, general manager of Perth City Council's electricity and gas department. Mr. Crocker was born in Utah (U.S.A.) 53 years ago. He became an engineer of the Deep Leads Electric Power Transmission Company, Victoria, in 1900, but in the following year went to Western Australia, and remained there.

Herr G. Graf.—The sudden death at the early age of 46 years is reported from Leipzig of Herr Ing. George Graf, technical director of the Schiele and Bruchsaler Industriewerke Gesellschaft, of Baden-Baden. The deceased was a leading German authority on switch manufacture.

Mr. A. E. Angold.—We regret to learn of the death of Mr. Arthur E. Angold, M.I.E.E., of Sutton Coldfield, near Birmingham.

Mr. Angold, who was in his 57th year, developed serious symptoms while engaged in his usual duties on April 8th; an emergency operation was performed, and he passed away two days later. His health had not been robust for some time past, and last year he went for a visit to South Africa, but unfortunately he only derived temporary benefit. He was educated in London, and also received his engineering training here. He invented his first arc lamp in 1890, and, working in conjunction with Torr Todman, he showed the Todman-Arnold arc lamp for the first time at the second Crystal Palace Exhibition. The Todman arc lamp was taken over by the General Electric Co., Ltd., in 1892, and Angold then joined the company, to which he gave 37 years valuable service. Angold lamps were made for many kinds of service, and widely adopted, but Angold by no means confined himself to lamps. His patents covered rotary convertors, motor convertors, transformers, winches, hand lamps, condensers, amplifiers, and many other electrical products. Special mention should be made of his work in connection with automatic sub-stations.

Mr. W. N. Sievers.—The death is announced in *The Times* of Mr. W. N. Sievers, general sales manager of Electrolux, Ltd. Mr. Sievers passed away on April 12th "following the last of countless operations."

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Cables & Wireless, Ltd., and **Imperial & International Communications, Ltd.**—Particulars of these companies, formed to carry out the wireless-cable merger, appear on p. 720 of this issue.

C. H. Stave, Ltd.—Private company. Registered April 11th. Capital, £1,500 in 1,060 5½ per cent. cumulative preference shares of £1 each and 8,800 ordinary shares of 1s. each. Objects: To carry on business as electrical, wireless, scientific and general engineers, manufacturers of and dealers in gramophones, electric light, and other electrical apparatus, &c. The directors are:—C. H. Stave, 182, Church Street, Kensington, W.8, electrical engineer (managing director); May F. Stave, same address, secretary. Registered office: 182, Church Street, W.8.

Astorea, Ltd.—Private company. Registered April 9th. Capital, £100 in 1s. shares. Objects: To carry on the business of constructors of and dealers in gramophones, electric gramophones, radio and wireless apparatus, telephones, telegraphic apparatus, &c. The subscribers (each with one share) are:—F. C. Green, 29-31, Portugal Street, W.C.2, solicitor; E. F. Power Green, 151, Thornbury Road, Isleworth, Middlesex, solicitor's articled clerk. Solicitors: R. H. Tetley, 29, Portugal Street, W.C.2.

Venreco, Ltd.—Private company. Registered April 11th. Capital, £8,000 in 4,000 10 per cent. cumulative preference and 4,000 ordinary shares of £1 each. Objects: To adopt an agreement with Reandco, Ltd., and W. S. Veness, and to carry on the business of manufacturers of and wholesale and retail dealers in all electrical fittings, appliances and component parts. The directors are:—A. L. Rea, 10, Stratton Street, S.W.1 (director, Rea, Warren & McLennan, Ltd.); Ethel M. Rea, 10, Stratton Street, S.W.1 (director of Reandco, Ltd.); E. P. Clift, 7, Bedford Square, W.C.1 (director, Reandco, Ltd.); W. S. Veness, 23, Lupus Street, Victoria, S.W.1. Registered office: 55, Neal Street, Long Acre, W.C.

Victors (Cambridge), Ltd.—Private company. Registered April 12th. Capital, £100 in £1 shares. Objects:—To carry on the business of manufacturers of, and dealers in radio and television sets and apparatus of all kinds, gramophones, &c. The subscribers (each with one share) are:—Ena Scott, 380, Monega Road, Manor Park, E.12, secretary; Eva G. Berryman, 28, Crown Road, St. Margarets, Twickenham, secretary. The first directors are to be appointed by the subscribers. Solicitors: Kenneth, Brown, Baker, Baker, Lennox House, Norfolk Street, W.C.2.

Radio Parts, Ltd.—Private company. Registered April 12th. Capital, £100 in £1 shares. Objects:—To carry on the business of manufacturers, importers and exporters of, and dealers in all kinds of electrical and other instruments, supplies and components in connection with wireless telegraphy, &c. The directors are:—S. Kremner, "The Quest," Okeover Road, Broughton Park, Salford; D. McGregor, "Alpine," Davyhulme, Urmston (both directors of the Samdon Wireless Co., Ltd.). Registered office: 41, John Dalton Street, Manchester.

Edison Storage Batteries, Ltd.—Registered as a private company April 8th. Capital, £12,000 in £1 shares. Objects: To carry on business as electricians, electrical and mechanical engineers, and manufacturers of and dealers in electric batteries, to manufacture, put up and use telephones, telegraphs (wireless or otherwise), phonographs, dynamos, accumulators, lamps, and all apparatus connected with the generation, accumulation, distribution, supply and employment of electricity. Power is taken to carry on the business of motor carriage, omnibus and other conveyance proprietors, &c. The first directors are:—R. H. Allen, Orange, New Jersey, U.S.A. (vice-president, Thomas A. Edison, Inc.); C. Edison, Orange, New Jersey (chairman, Thomas A. Edison, Inc.); M. E. Fox, 5, Pembridge Gardens, W.2, engineer (director, Société Continentale de l'Accumulateur Edison S.A.); J. Millar, Orange, New Jersey (manager, export division, Thomas A. Edison, Inc.); A. F. Wagner, 42, Meadway, N.W.11 (director and manager, Thomas A. Edison, Ltd.). Secretary: M. E. Fox. Registered office: Victoria House, Southampton Row, W.C.1.

W. R. Bottomley & Co., Ltd.—Private company. Registered April 6th. Capital, £3,000 in £1 shares. Objects: To acquire the business of an electrical engineer carried on by W. R. Bottomley at Providence Electrical Works, Marsh, Huddersfield, as the "W. R. Bottomley Private Telephone Co.," and to carry on the business of wireless, mechanical and general engineers and engineering contractors, consulting wireless experts, manufacturers of and dealers in radio and telephone apparatus and supplies, wireless service agents, &c. The subscribers (each with one share) are:—W. R. Bottomley, Glynwood, Daisy Road, Brighouse, Yorkshire, electrical engineer; J. Magee, Byram Arcade, Huddersfield, incorporated accountant. The first directors are: W. R. Bottomley and Annie Bottomley (both permanent).

Official Returns of Electrical Companies.

Basil Marsh, Ltd.—Particulars filed of £700 debentures authorised March 4th, 1929, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

Bower Electric (1926), Ltd.—P. J. Chaplin, C.A., 8, Staple Inn, W.C., was appointed receiver and manager on March 27th, 1929, under powers contained in debentures dated September 15th, 1926.

Laurie & Stuart, Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital dated March 26th, 1929, to secure all moneys due or to become due from the company to Lloyd's Bank, Ltd

Cleartron (1927), Ltd.—Particulars filed of £10,000 debentures, authorised March 8th, 1929, charged on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £2,500.

Nelson Bros., Ltd.—Charge on 2, Regent Road, Blackpool, dated March 21st, 1929, to secure all moneys due or to become due from the company to Martin's Bank, Ltd.

London Electric Warehouse Co., Ltd.—Capital, £1,000 in £10 shares. Return dated December 31st, 1928. 8 shares taken up. £10 paid, £70 calls unpaid. Mortgages and charges, nil.

Bogota Telephone Co., Ltd.—Capital, £300,000 in £1 shares. Return dated January 14th, 1929. 258,493 shares taken up. £248,993 paid. £12,500 considered as paid. Mortgages and charges, nil.

W. G. Cannon & Sons, Ltd.—Capital, £3,000 in £1 shares. Return dated December 31st, 1928. All shares taken up. £9 paid. £2,991 considered as paid. Mortgages and charges, nil.

Delagoa Bay Development Corporation, Ltd.—Capital, £166,300 in 267,400 ordinary shares of 10s. each and 133,400 preference shares of 5s. each. Return dated December 4th, 1928. 267,400 ordinary and 68,400 preference shares taken up. £105,800 paid on 177,400 ordinary and 68,400 preference shares. £45,000 considered as paid on 90,000 ordinary shares. Mortgages and charges, £209,350.

Grierson, Ltd.—Capital, £10,000 in 4,000 preference and 6,000 ordinary shares of £1 each. Return dated December 25th, 1928. 4,001 ordinary shares taken up. £4,001 paid. Mortgages and charges, nil.

City Notes.

Nigerian Electricity Supply Corporation, Ltd.

On Tuesday last this company offered the whole of its preferred ordinary shares of £1 each (450,000) for subscription at par. The balance of the capital is £200,000 in £1 ordinary shares. The preferred ordinary shares are entitled to a fixed non-cumulative dividend of 7½ per cent., and after the ordinary shares have received a similar amount, they participate to the extent of one-fourth in the surplus available for dividend. The Corporation was formed to acquire and complete a hydro-electric installation designed to provide power for the tin mines of the Bauchi Plateau, Nigeria. It has a 45-year concession and the right of a 20-year extension. The power of the Kurra Falls is being harnessed; the initial installation consists of three 2,000-h.p. sets, and additional plant is being installed to give 6,000 h.p. continuously and 10,000 h.p. maximum. The construction of a dam with a storage of 2,900 million gallons is well advanced. The company has contracted to supply 6,000 h.p.

at a cost of 1½d. per h.p.-hour, and contracts for a further 2,300 h.p. are in hand. The chairman of the Corporation is the Hon. Lionel Holland, and the directors include Mr. M. A. Edwards, a director of the Derbyshire and Notts. Electric Power Co., and Maj.-Gen. A. C. J. de Lotbiniere, a director of the British Thomson-Houston Co., Ltd. The initial gross revenue is put at £120,000, rising to £180,000, and the net revenue at about £100,000, rising to £150,000.

Babcock & Wilcox, Ltd.

The net profit for the year ended December 31st last was £734,902, as compared with £743,820 for 1927. To this is added £125,362 brought forward, making £860,264. The final ordinary dividend is 8 per cent., free of tax, again making 15 per cent. for the year. The reserve fund receives £50,000 (against £100,000), and the staff pension fund £32,000 (against £20,000), leaving £118,363 to be carried forward. The report records the death of three directors—Mr. C. A. Knight, Mr. A. T. Simpson, and Sir Coles Child, Bt. Considerable extensions and additions to the works have been, and are being, made to meet the increasing demand for high-pressure boilers. These extensions include, it is claimed, the largest plate-bending press and corresponding riveter hitherto erected. The associated companies continue to show good results, the total income therefrom being satisfactory. The directors have decided to put the staff pension fund on a contributory basis, the company giving £1 for each £1 of the contributions of the members of the staff. Sir Robert B. Dixon, K.C.B., and Col. P. D. Ionides, D.S.O., have been appointed directors. Meeting: April 23rd.

Companies Struck off the Register.

The names of the undermentioned companies have been struck off the Register, and they are thereby dissolved:—

Anode Wireless and Scientific Instruments, Ltd.
Associated Electric Traders, Ltd.
British Radio Sales Co., Ltd.
Coventry Wireless Supplies, Ltd.
Consolidated Diesel Engine Manufacturers, Ltd.
Diamond Wireless, Ltd.
Electric Lamp Regenerators, Ltd.
Electrolite, Ltd.
Holborn Electric Fires, Ltd.
Holborn Radio Co., Ltd.
Jenner Light and Power Co., Ltd.
Maywood Engineering and Electrical Manufacturing Co.,
Mitchell's Electrical and Wireless, Ltd.
Modern Electrical Supply Co., Ltd.
New Vacuum Cleaner Co., Ltd.
Ltd.
Park Royal Engineering Works, Ltd.
Prendergast Electrical Engineering Co., Ltd.
Re-Echo Electrical Manufacturing Co., Ltd.
Swift Electrical, Ltd.
Tele Dis Services (Founders Co.), Ltd.
Uni-Directional Apparatus Co., Ltd.
Wireless Installations, Ltd.

Direct Spanish Telegraph Co., Ltd.

After meeting all expenses and adding a balance of £1,083 brought forward, the profit for the year ended December 31st last was £3,638. In order to provide for the exceptional expenditure, £7,817 has been transferred from the contingencies fund, making a total available balance of £11,455. The preference dividend is paid, and 10 per cent., free of tax, is distributed on the ordinary shares, leaving £1,990 to be carried forward. Interruptions on the Bilbao-Porthcurnow and Marseilles-Barcelona cables were attended to during the year. The report records the death of Sir John Denison-Pender, the chairman, and the appointment of Mr. J. C. Denison-Pender in his place. Admiral H. W. Grant, C.B., has joined the board. The meeting was to be held on Wednesday last.

Brompton and Kensington Electricity Supply Co., Ltd.

The annual meeting was held on April 12th, Mr. H. R. Beeton (chairman) presiding. In moving the adoption of the report, the chairman said that a partial bulk supply from the London Power Co. was commenced in August last and a full supply in October, when the power station was closed down. The accomplishment of the new system necessitated the erection of a new transforming and bulk-distributing station, and the change of periodicity of the supply from 83 cycles to the standard 50 cycles. It involved an inventory being taken on the premises of approximately 11,000 consumers, the changing of 160 street transformers, and the replacement and adjustment of 12,000 meters, as well as the substitution, renewal, or adjustment of over 500 motors, lifts, and other apparatus. The cost of this work, with concurrent alterations, had involved a capital expenditure of nearly £70,000. Reduced charges had resulted in an increase of 14 per cent. in the sales of electricity. The report and accounts were adopted.

Kiesselbach Steam Accumulators, Ltd.

Speaking at the annual meeting on April 11th, the chairman (Sir Henry P. Maybury, G.B.E.) said that since the formation of the company a highly satisfactory number of requests for tenders had been received, and in dealing with those alone they would be working to more than capacity. Two tenders had already been accepted. Their consulting engineer (Mr. Rosencrants) reported that a very wide scope existed for the accumulators. They had decided to defer the question of the disposal of the American rights until they were further advanced in this country.

Notting Hill Electric Lighting Co., Ltd.

The report for 1928, which is to be presented at to-day's annual meeting, records a profit of £91,734 (including £27,744 brought forward). From this are deducted debenture interest, sinking fund contributions, &c., leaving £55,978. After the payment of the preference and standard deferred dividends, £1,891 is reserved for distribution as co-partnership bonus to the staff, and £28,978 is carried forward. The standard deferred dividend is raised from 13s. 7.636d. to 14s. 4.006d. per share owing to the fact that the company has been able to sell energy below the standard prices fixed in accordance with the provisions of the sliding scale under the 1925 Act. The connections rose from 16,329 to 18,017 kW, and the sale of energy from 6,975,960 to 7,640,091 kWh. The balance of the £25,000 of 7½ per cent. seven-year notes issued in 1921 was redeemed during the year.

Chelsea Electricity Supply Co., Ltd.

The annual meeting was held on April 11th. Mr. W. R. Davies (chairman), who presided, said that he hoped that by the end of this year it would be possible to reduce the charges for lighting from 5½d. to 4½d. per kWh, and for power from 1½d. to 1d. per kWh. The development of the company was not so rapid as that of some other concerns. This was due to the fact that it had a curiously constituted area. There was a very rich portion, where the demand for electricity was practically complete, and there was a large undeveloped area in which, as things were at present, very little could be done. Sir John Ellerman had bought a considerable amount of property, however, for the erection of better-class buildings, and as this property developed there should be considerable progress in the supply of electricity. The report and accounts were adopted.

South Wales Electrical Power Distribution Co.

The accounts for the year ended December 31st, 1928, show a credit balance of £89,060, as compared with £125,068 in 1927. After meeting debenture interest, there remains £24,990 (against £61,002). It is proposed to transfer £15,000 (against £44,220) to the depreciation reserve account, and to pay the dividend on the 5 per cent. preference shares, leaving a balance of £3,724 to be paid over to the South Wales Power Co., Ltd. The report records the death of Mr. W. A. Chamen, who was elected a director at the last annual meeting. Meeting: April 26th.

South Wales Power Co., Ltd.

After reviewing the accounts of the Distribution Co. (see above), the report for 1928 states that the total income from holdings in the Distribution Co., &c., amounted to £58,205, as compared with £66,496 for 1927. To this is added £20,706 brought forward, making £78,911. From this debenture interest and the dividend on the 6½ per cent. cumulative preference shares are paid, leaving a balance of £21,182, which it is proposed to carry forward. The directors consider that in view of the acute industrial depression which was even more pronounced last year than in 1927, the results obtained are as satisfactory as could be expected. Meeting: April 26th.

Gateshead and District Tramways Co.

The revenue for the year ended December 31st last fell by £6,691 to £121,405, while the expenses decreased by £385 to £703,116. The net profit thus fell from £24,595 to £18,289. To this is added £21,369 brought forward, making £39,658. The preference dividends are paid; the ordinary dividend is reduced from 10 to 6 per cent.; and £18,895 is carried forward. The traffics were adversely affected by the depressed state of trade in the district and by the closing to tramway traffic of a section of the Dunston route owing to the reconstruction of a road bridge.

Jarrow and District Electric Traction Co., Ltd.

The revenue for the past year amounted to £8,195 (against £9,806) and the available balance (which it is proposed to carry forward) to £427, including £1,202 brought in. The company has lodged a Bill in the present session of Parliament providing for the abandonment of the light railways, &c., and the substitution of omnibuses.

Wycombe (Borough) Electric Light and Power Co., Ltd.

The accounts for the year ended December 31st, 1928, show a profit of £13,852 (against £15,072) after providing for debenture interest, preference dividends, &c., and adding £1,272 brought forward. The final divided on the old ordinary shares is 6 per cent., free of tax, again making 10 per cent., free of tax, for the year. The 17,000 ordinary shares issued during the year receive a dividend of 5 per cent., free of tax. The general reserve account receives £750 and the staff benevolent fund £250, leaving £1,202 to be carried forward.

London Electric Wire Co. & Smiths, Ltd.

The annual meeting took place on April 11th, Sir George H. Fisher-Smith (chairman) presiding. After reviewing the accounts (*vide* our last issue, p. 666), the chairman said that the general reserve now stood at £200,000, and the special reserve at £150,000. The increase of £14,662 in the profit did not accurately reflect the much larger turnover, as a considerable amount of business had had to be taken at very cut prices. The results, however, could be considered satisfactory; the company had been able to maintain its position in the trade in spite of exceptionally keen competition. The introduction of "rationalisation" had brought about many changes in industry during recent years; the board was giving serious attention to that problem with a view to taking such steps as were considered to be in the best interests of all parties concerned. During the latter part of 1928 up to the present time trade had been more stable and, unless anything unforeseen happened, the future could be regarded as distinctly hopeful.

Pinchin, Johnson & Co., Ltd.

At an extraordinary meeting on April 10th a resolution was passed providing for the sub-division of the £1 ordinary shares into 3,000,000 10s. ordinary shares. The chairman (Mr. E. Robson) explained that the alteration would tend to increase the number of shareholders and would thus lead to a wider and freer market for the company's products and shares.

Shropshire, Worcestershire and Staffordshire Electric Power Co.

The directors recommend the following dividends: "A" ordinary shares—Final dividend of 4 per cent. (actual), making 8 per cent. for the year. "B" ordinary shares—Dividend of 7½ per cent. for the year.

British Insulated Cables, Ltd.

At an extraordinary meeting on Tuesday this week the shareholders approved the directors' proposals to create 333,333 ordinary shares and 500,000 5½ per cent. cumulative preference shares of £1 each, and issue these *pro rata* to the ordinary shareholders as a bonus.

Lancashire Electric Light and Power Co., Ltd.

On Wednesday last this company offered for subscription 600,000 £1 ordinary shares at 27s. per share, raising the issued capital to £3,111,440. The proceeds are required to complete the first two 42,000-h.p. units in the new Kearsley station, for mains and for the general development of the area.

Clyde Valley Electrical Power Co., Ltd.

An extraordinary meeting is called for April 24th to consider resolutions providing for the cancellation of the 200,000 unissued cumulative second preference shares, and empowering the directors to create and issue 900,000 ordinary shares of £1 each to be offered at par to the ordinary shareholders in the proportion of one new share for each four held.

Cammell, Laird & Co., Ltd.

After providing for debenture interest and depreciation, the financial result for the year ended December 31st last was a loss of £80,694, against £112,046 in 1927. £75,000 (against £125,000) is transferred from the reserve, providing a credit balance of £5,921 to be carried forward. The dividend on the preference shares is in arrear as from June 30th, 1925.

Oxford Electric Co., Ltd.

The net revenue for the past year fell from £64,247 to £45,382, due mainly to reductions in charges and increased working expenses consequent upon the enlargement of the power station. The ordinary dividend is maintained at 8½ per cent., £25,000 is placed to reserve and renewal of plant account, and £6,448 is carried forward.

West London and Provincial Electric and General Trust, Ltd.

From the profits of the past year the directors propose to place £2,500 to general reserve, to pay a final ordinary dividend of 5½ per cent., making 10 per cent. for the year (as for 1927), and to carry forward £5,761.

Anglo-Portuguese Telephone Co., Ltd.

A final dividend of 5 per cent., making 8 per cent. for the year (as for 1927), has been declared. The dividend on the "A" ordinary shares is 8 per cent.

Indo-European Telegraph Co., Ltd.

The directors announce a final dividend of £1 2s. 6d. and a bonus of 15s. per share, making 10 per cent. (free of tax) for the year, as for 1927.

Brazilian Traction, Light and Power Co.

A quarterly dividend of 50 cents per share has been declared on the ordinary no-par-value shares.

Stocks and Shares.

Monday Evening.

The Budget effect upon Stock Exchange markets will not become manifest until the day after that on which these notes are being written. It would appear, from a preliminary study of the Chancellor's speech reported in the papers this—Monday—evening, that anticipation will be tolerably well satisfied by what Mr. Winston Churchill has done in the way of balancing his Budget. The market for gilt-edged stocks had been dull in advance of the statement, some little apprehension being felt as to a possibility that he might tamper with the Sinking Fund. It was generally agreed that the Chancellor had little chance, if any, of remitting income taxation.

Cable and Wireless, Ltd.

The outstanding feature of the week, so far as electrical markets are concerned, is found in the result of the publication of the Cable & Wireless, Limited, details, of which brief particulars were set out in these pages a week ago. The full scheme is published in the present number, but the salient features appeared on page 667 in last week's paper. The figures were in remarkably close accordance with what had been expected in the Stock Exchange, so far as the cable companies were concerned. We have said on many previous occasions that anticipation, regarded by some as a little optimistic, looked for the distribution of stock or shares that would give to Eastern ordinary stock a value of about £300 per £100 stock, and to the £10 shares of the Eastern Extension and the Western companies, the equivalent price of £30. The event shows that these values are likely to be reached, although for the moment Eastern ordinary is 282, and the shares of the other two companies stand at 28¼ or thereabouts. Globes have strengthened to 28. When a market starts in the new shares, it will be in the 5½ per cent. cumulative preference shares of £1 each in Cable & Wireless, Ltd., and 7½ per cent. "A" ordinary shares, also of £1 each, together with "B" £1 ordinary shares. Many people think that the preference will be worth more than their par value, and that the ordinary shares should stand nearer 22s. than £1.

Cable "B."

What the value of the "B" shares is likely to prove, it is difficult to say. The bullish way of looking at it is to assume that America will be a keen buyer of the "B" shares, and will be ready to pay up to 30s. or 40s. Dealings are said, indeed, to have taken place already at 30s. in the "B" shares. The value of the "B" is problematical, and at the present stage of the new company, 25s. seems to be a reasonable valuation to put upon them, in view of the possibility that they may receive no dividend for a year or two. They carry, however, the equity of the business, and it is this which gives the shares their speculative possibilities.

Marconis.

Speculative excitement has occurred in Marconis, which is only natural, in view of the lively gambling that had taken place in advance. This time last week, the price was standing at about 86s. 3d., from which there was a drop to 82s. 6d. on publication of terms that disturbed the optimism of the holders of Marconi £1 shares. It has been pointed out all along that, if there were any certainty of the £1 shares being treated as of value precisely double that of the 10s. shares, such discrepancy as existed between the quotations for the two would hardly obtain, and that this discrepancy indicated the scope which existed for possible disappointment when the terms became known. A chorus of protest promptly arose, and a committee of the dissentients is said to have been constituted. The price of the £1 shares ran up to 5¾ on the eve of the announcement being made, from which it fell back to 4¾, recovering later to £5 a share. Until it becomes clear whether or not the dissentient holders of the £1 shares are going to take legal action in order to see if the status of their shares is higher than that assumed by the company, it is quite possible that the market for Marconis will remain in a jerky and, possibly, a dullish state.

But when everything has settled down, the promise is for better prices, and the speculative investor is likely to agree that there is a prospect of improved values as soon as the present dust of controversy has been brushed away.

Other cable stocks are good, a rise of £2 in Great Northern Telegraphs taking the price to 34. Anglo-American preferred at 102 is ex dividend. Marconi Marines are a better market at 3¼ bid.

Telegraph Constructions.

Telegraph Construction & Maintenance shares, quoted ex dividend last week, and now standing at 24¼, become interesting by reason of the merger. The company for years past has been paying dividends of 10 per cent. free of tax, and the shares are of the unusual denomination of £12. The Tele-

graph Construction & Maintenance among its other activities produces "loaded" cable, and it would seem as though the new merger is likely to provide the company with a good deal of business. There was some talk, a little while ago, of the American companies negotiating with the Telegraph Construction & Maintenance, but nothing has lately been heard of this, and the rumour may be merely gossip. The cable-wireless merger is likely, however, to lead to further developments in the future; and, humdrum though Telegraph Construction shares look as an industrial investment, holders will probably consider it worth while to retain their interest in the hope of future developments.

Electricity Supply.

Several of the deductions of dividends that were made last Thursday, the Stock Exchange pay-day, from prices in the Electricity Supply list, have been regained. Midland Electric Power, Clyde Valley, Newcastle-on-Tyne ordinary and 7 per cent. preference are amongst others which are quoted at the same prices ex dividend, as they were at the immediately-previous cum. dividend figures. Save for these gains, the list is unusually quiet. County of London ordinary hardened a few pence to 53s. Lancashire Light & Power ordinary remain at 30s. unaffected by the announcement of a new issue of shares at 27s. This would not include, of course, the dividend of 1s. 6d. per share dividend carried by the price of the existing issue. Atlas at 26s. 3d. are ex 4 4-5d. dividend. Egham & Staines are ex 1s. 6d. at 34s. 6d., and Isle of Thanet preference at 25s. 6d are ex 7 1/5d. all less tax.

"Approximate" Dividends.

It may have been observed that our price lists are brought as nearly as possible up-to-date by the addition of the dividends for 1928. The catalogue cannot be completed, it is obvious, until all the companies have published their accounts. In a certain number of the London electricity supply shares, the dividends are at rates which run into decimals to four places. We have taken the rates nearest to what might be termed round fractions, and this is the reason why the dividend columns in our tables are headed with the word "approximate." As mentioned on previous occasions, the yield on the money is calculated in most cases not upon the dividends at present being paid, but upon the 7 per cent. standard rate, to which the majority will decline after 1931. This system of working seems to be less liable to mislead the investor than that of working out the return on the basis of the distributions still being made by the companies.

The dividends on manufacturing companies' shares will be altered to the 1927-1928 figures when the table can be made more complete than is the case at present.

Manufacturing Companies.

Enfield Cable shares hold their last week's improvement to 4½. General Electrics developed spasmodic activity and gained 1/16 at 3 1/16. British Insulated ordinary at 4 9/16 are ex the dividend, allowing for which the price is practically unchanged. At 2⅜ British Aluminium also are ex dividend, thus being about 1s. harder on the week. English Electric weakened to 7s. There is a little speculation in the shares of the Telephone Manufacturing Company, on a hope that some modest distribution may be made, three months hence. The current price is 6s. 1½d. for the 10s. shares. Vickers six-and-eightpenny shares are dull at 10s. 10½d. ex the 8 per cent. dividend. A decline of 1/16 to 3⅜ in Babcock & Wilcox, reflects the mild disappointment at the dividend for the year, being left at 15 per cent. free of tax. This is the same rate as before: some people had hoped the dividend would be raised to 16 or 17 per cent., but the accounts show that an increase would have been hardly justifiable.

Railways and Traction.

Metropolitan Railway consolidated is up a point to 61½. Underground Electric Railway Incomes are 2 higher at 114, regaining the loss which, a week ago, was indicated here as being difficult to explain. Districts keep steady at 76½, the return at this price being 6½ per cent., a yield that makes the stock look moderately valued, in view of the company's hopeful prospects.

Brazilian Tractions firmed up to 62. Para Electric Railways preference have gone back to 18s. 9d. In the group of Mexican utilities, Mexican Light & Power common advanced 2½ to 82½. Amongst other foreign descriptions, Perak Hydro-Electrics turned dull, and lost 1s. at 17s. 6d., the debenture stock at 117 being put down a point. Hydro-Electrics recovered their previous week's loss, rallying to 37, though International Holdings, their stable companion, further declined to 8⅛. Shawinigan Water at 74½ shows a drop of 2, and has been still lower. "Dollar" stocks remain under the dominating influence of New York and Montreal, in both of which centres the effects of last month's sharp attack of financial indigestion have not wholly worn off.

Nigerian Electricity.

An interesting newcomer is the Nigerian Electricity Supply Corporation, which has been offering 450,000 perferred ordinary shares of £1 each. The company holds a 65 years' concession to utilise the Kurra Falls, in Northern Nigeria, for generation of hydro-electric power. The prospectus stated that the supply of electric power is expected to start next January.

Share List of Electrical Companies.

Home Electricity Companies.

	Nom.	Approx. Dividend. 1927.	1928.	Price April 15 1929.	Rise or fall	Yield p.c.
	£					
Bournemouth and Poole	1	15	—	£4/6	—	... ...
Brompton Ordinary	1	8½	8½	27/-	—	5 3 8
Charing Cross Ordinary	1	8½	8½	26/-	—	5 7 8
do. do. 4½% Pref. ...	1	4½	4½	17/6	—	5 2 10
Chelsea	1	8⅞	8⅞	27/-	—	5 3 8
City of London	1	10	10	32/-	—	4 7 6
do. do. 6% Pref.... ...	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	43/3xd	+9d.	3 14 1
County of London	1	7½	10	53/-	+6d.	3 15 6
do. do. 6% Pref.... ...	1	6	6	23/-	—	5 4 4
Edmundson's 7% Pref.	1	7	7	25/-	—	5 12 0
Elec. Supply Corporation	1	11	—	55/-	—	4 0 0
Kensington Ordinary	1	8	8	26/6	—	5 5 8
Lancs. Light and Power	1	7½	7½	30/-	—	5 0 0
London Electric	1	8½	9	27/-	—	5 3 8
Metropolitan	1	9	9	2 7/8	—	4 7 4
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	6½	6½	28/-	—	4 12 10
Mid. Elec. Power	1	15	8	36/3xd	+1/-	4 2 9
Newcastle on-Tyne Ordinary ...	1	6	6	1½xd	+6d.	4 16 0
do. 7% Pref.	1	7	7	26/-xd	+6d.	5 7 8
Notting Hill 6% Pref.	10	6	6	10⅔	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	23/-	—	5 4 4
St. James' and Pall Mall	1	8	8	27/6	—	5 1 10
Scottish Power	1	8	8	31/-	—	5 3 3
South London	1	8½	8½	27/6	—	5 2 8
Urban Ordinary	1	7	—	4⅜	—	... ...
Westminster Ordinary	1	8½	8½	26/-	—	5 7 8
Whitehall Elec. Invst. 7½% Pref. ...	1	7½	7½	23/6	—	6 7 8
Yorkshire Elec.	1	8	8	34/-	—	4 14 2

Home Rails.

Central London Ord. Assented ...	Stock	4	4	72	—	5 11 1
Metropolitan	,,	3	3½	61½	+1	5 13 10
do. District	,,	4	5	76½	—	6 10 9
Underground Electric	£1	5	7	23/6	—	5 13 10
do. do. Income ...	Bonds	6	6	114	+2	5 5 3

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	102xd	—	5 17 8
do. Def.	,,	1½	1½	24	—	6 3 9
Automatic Telephone	1	10	12½	2 7/8	—	5 14 2
Eastern Extension	10	10	10	28xd	—	*3 11 5
Eastern Tel. Ord.	Stock	10	10	282xd	+4	*3 11 0
Globe Tel. and T. Ord.	10	10	10	28	+⅛	*3 11 5
do. do. Pref.	10	6	6	11½	—⅛	5 9 0
Great Northern Tel.	10	20	—	84	+2	... ...
Indo-European	25	10	10	5⅝	—	*4 10 0
Marconi	10/-	10	—	4 1/8	—	... ...
Marconi-Marine	1	12½	15	8⅜	—	4 16 0
Oriental Telephone Ord.	1	12	—	2⅞	—	... ...
Western Telegraph	10	10	10	28½xd	—	3 11 0

Home and Foreign Trams, &c.

Anglo-Arg. Trams First Pref. ...	5	5½	5½	8 1/16	—	7 9 3
do. do. 2nd Pref. ...	5	6	6	8⅞	—	7 14 10
do. do. 5% Deb. ...	Stock	5	5	72½	—	6 18 0
British Electric Traction Def. Ord.	,,	5	—	850	—	... ...
do. do. Pref. Ord.	,,	8	8	128	—	6 5 0
Brazil Traction	100	7	8	62	+1	3 4 6
Brit. Columbia Elec. Rly. Pcc. ...	Stock	5	5	95½	—	5 1 7
London & Sub. Trac. 5% Pref. ...	1	Nil	Nil	12/-	—	... ...
London United Tram Deb. ...	Stock	4	4	61	—	6 11 4
Mexico Trams, 5% Bonds	—	5	5	69½	—	7 4 0
Mexican Light Common	100	Nil	Nil	82½	+2½	... ...
do. 7% Pref.	100	7	7	75½	—	9 5 6
do. 1st Bonds	—	5	5	77½	—	6 9 0
Yorkshire (West Riding)	1	Nil	Nil	5/-	—	... ...

Manufacturing Companies.

		1926.	1927.			
Assoc. Elec. Ord.	1	—	—	38/3	—	... ...
Babcox & Wilcox	1	13	15	3⅜	—1/16	*4 8 9
British Aluminium Ord.	1	10	10	47/6	—	*4 4 2
British Elec. Transformer Pref. ...	1	7	7	15/-	—	9 6 8
British Insulated Ord.	1	15	15	4 1/2	—	3 6 0
Brush Ord.	1	10	10	27/6	—	7 5 6
Callenders	1	15	15	4⅜	—	3 9 0
do. 6½% Pref.	1	6½	6½	1½	—	5 4 0
Crompton Parkinson Ord.	5/-	—	—	1	—	... ...
do. 8% Pref.	1	—	8	25/-	—	6 8 0
Edison-Swan 1st Pref.	1	7½	7½	25/9	—	7 1 2
do. 5% Deb.	Stock	5	5	86½	—	5 15 7
Electric Construction	1	7½	7½	1	—	7 10 0
Enfield Cable Ord.	1	20	20	4½	—	4 17 0
English Electric	1	Nil	Nil	7/-	—6d.	... ...
do. do. Pref.	1	8	Nil	9/6	—	... ...
Gen. Elec. Pref.	1	6½	6½	24/6	—	5 6 1
do. Ord.	1	7½	10	3 1/8	+1/8	3 5 8
Henley	1	25	25	6	—	4 1 8
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	Nil	Nil	13/9	—	... ...
Johnson & Phillips	1	12½	10	1 1/8	—	5 3 1
Siemens Ord.	1	7½	7½	1⅜	—	5 9 1
Telegraph Construction	12	10	10	24½xd	—½	*4 19 3

* Dividends paid free of Income Tax.

Our Foreign Electrical Trade.

Electrical Exports and Imports during March.

In examining the Board of Trade Returns for March it has to be remembered that the month not only included five Sundays, but also that the Easter Holidays occurred at the end of the month. So far as foreign trade generally was concerned, this led to decreases in both imports and exports during March, as compared with the corresponding month of last year. This, however, does not explain away the fact that while electrical exports decreased, imports of this class rose in value.

Dealing first with the exports it will be seen that there was a decrease of £89,674 as compared with the February figure. This decrease was general but most marked in the cases of telegraph and telephone apparatus (£59,208), non-submarine telegraph and telephone wires and cables (£38,969), batteries and accumulators (£36,366), and unenumerated electrical machinery (£30,651). The total decline in the telegraph and telephone section was £101,546. Against these were set four increases of which only two were of any magnitude, namely, unenumerated goods and apparatus (£68,741), and railway and tramway motors (£20,687). In comparison with March, 1928, there was a decrease of over 20 per cent., there being only three increases all of negligible proportions. The electrical machinery section showed a total decline of £158,177. The telegraph and telephone class recorded a total decrease of £160,773, including the largest fall in the list—£113,670 in the case of instruments and apparatus. In the goods and apparatus section the greatest decreases occurred in the cases of batteries and accumulators (£25,554), and insulated wires and cables (£24,534). The result of the fall in the total was to bring the exports for the first quarter of the year to £324,460 below the figure for the first three months of 1928.

The following table shows the distribution of our electrical machinery exports during March, and the figures are compared with those for March, 1928 :—

Destination.	March, 1928. £	March, 1929. £	Inc. or dec. £
Europe	61,457	68,563	+ 7,106
Japan	26,109	7,911	−18,198
South America	84,895	48,160	−36,735
South Africa	49,949	29,619	−20,330
British India	133,339	162,466	+29,127
Australia	124,653	73,215	−51,438
New Zealand	39,531	20,430	−19,101
Canada	17,362	13,319	− 4,043
Other countries	107,137	62,572	−44,565
Totals	£644,432	£486,255	−£158,177

Having regard to the general decrease it is satisfactory to see the rises in the figures for British India and Europe. Conversely the falls in the cases of Australia, New Zealand and South Africa are not encouraging. The proportion between the amounts taken by foreign and Empire markets remained about the same.

The increase in imports as compared with February was fairly generally distributed over the items. Electrical machinery recorded the greatest rise (£29,023), and the only other outstanding advance was £28,179 in the case of glow lamps. There was a fall of £11,778 in the telegraph and telephone section. The increase upon the March, 1928, total was £56,527 and this was mainly due to larger imports of telegraph and telephone apparatus, this item showing a rise of £49,252. Apart from this there were no outstanding variations, with the possible exception of a fall of £7,891 in imports of non-submarine telegraph and telephone wires and cables. The total for the first quarter of the year is £110,160 above that for the corresponding period of 1928. The re-export section shows declines in both comparisons and only the decreases in the machinery section are of any note.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for Mar., 1929.	Inc. or dec. as compared with Feb., 1929.	Inc. or dec. as compared with Mar., 1928.	Electrical imports for Mar., 1929.	Inc. or dec. as compared with Feb., 1929.	Inc. or dec. as compared with Mar., 1928.	Electrical re-exports for Mar., 1929.	Inc. or dec. as compared with Feb., 1929.	Inc. or dec. as compared with Mar., 1928.
Electrical goods and apparatus (unenumerated)	£246,948	+ £68,741	+ £7,407	£124,557	+ £4,017	+ £9,915	£7,411	+ £147	+ £331
Insulated wires and cables ...	228,412	+ 9,352	− 24,534	59,447	+ 2,966	− 2,258	734	+ 194	− 383
Glow lamps	39,648	− 4,345	+ 1,105	49,101	+ 28,179	+ 6,559	988	+ 123	− 41
Arc lamps and parts ...	631	− 1,941	− 439	831	− 189	− 1,633	2	− 151	− 86
Batteries and accumulators ...	77,190	− 36,366	− 25,554	44,788	+ 983	+ 2,071	102	− 105	− 369
Meters and instruments ...	26,019	− 738	− 12,370	22,927	+ 5,090	+ 439	772	+ 260	+ 368
Carbons	158	− 519	− 2,225	18,525	+ 5,592	+ 8,213	16	− 208	− 243
Switchboards (not telegraph or telephone)	5,631	+ 3,210	+ 3,327	157	− 675	− 171	—	—	− 100
Electrical Machinery—									
Electrical machinery (unenumerated)	293,597	− 30,651	− 53,811	149,803	+ 29,023	− 7,969	6,20	− 2,419	− 7,450
Railway and tramway motors	52,411	+ 20,687	− 18,223	—	—	—	—	—	—
Other motors and generators...	140,247	− 15,558	− 86,143	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	40,525	− 38,969	− 30,608	3,531	− 4,961	− 7,891	—	− 45	—
Submarine telegraph and telephone cable	2,614	− 3,369	− 16,495	—	—	—	4	+ −4	+ 4
Telegraph and telephone instruments and apparatus ...	218,600	− 59,208	− 113,670	98,297	− 6,817	+ 49,252	2,540	− 426	+ 514
Totals	£1,372,691	− £89,674	−£372,233	£572,024	+ £63,208	+ £56,527	£18 774	− £2,626	− £7,455
	Exports			Imports			Re-Exports		
Inc. or dec. for three months ...	− £324,460			+ £110,160			−£9,439		

Registered Electrical Contractors.

The Annual Meeting and Report of the Registration Board.

THE annual meeting of the board of the National Register of Electrical Installation Contractors was held at the Institution of Electrical Engineers on Monday last. Mr. P. V. Hunter (chairman) presided and presented the report of the Executive Committee which is reviewed below. Mr. R. A. Ure suggested that the Register was not sufficiently advertised in Scotland and that a Scottish Committee should be formed to put its objects before consultants, architects and others. Mr. F. W. Purse pointed out that the E.C.A. of Scotland was represented on the Executive. The chairman promised that the matter would be sympathetically considered by the Executive. Mr. W. R. Rawlings seconded the adoption of the report which was carried. The nominations to the Executive Committee were confirmed; Mr. P. V. Hunter was re-elected chairman and Mr. A. H. Dykes vice-chairman. The Committee asked for approval of a draft setting forth certain points of bad workmanship which rendered contractors liable to be struck off the Register. These were as follows:—

(1) Over-rating of mains, sub-mains or sub-circuits and all controlling apparatus connected therewith. (2) Inadequate methods of ensuring the electrical and mechanical continuity of metal-sheathed cables and conduit systems and lack of permanent earthing connections. (3) Leaving the ends of tubes at switch points, lighting points or distribution boards without suitable bushing by protective nipples or by a suitable outlet-box, or wood block. (4) On concealed tube systems failure to provide a suitable outlet which would protect the wire right up to the surface of the wall or ceiling; or alternatively failure to bring the tube through to the surface of wall or ceiling. (5) In the case of metal-sheathed, tough-rubber-sheathed and similar cables, failure to bring the whole of the protective covering through to the surface of wall or ceiling. (6) Failure to keep clear of used or disused gas pipes in such a manner that they could be brought into accidental contact with the wiring or its conduits. (7) The insertion of more wires in a conduit than would allow of at least one more wire of the same size as the largest already in the conduit, being easily pushed in for a distance of six inches. (8) The absence of reasonable precautions to safeguard against risks of fire and shock. (9) The employment of inadequately paid labour and the use of boys in unreasonable proportion to that of fully-qualified wiremen. A letter was read from Mr. J. J. Foggo (E.C.A. of Scotland) in which he considered that the proposals did not go far enough. He maintained that 15-A plugs and sockets, &c., should be insisted on for all power points; that screwed conduit and conduit boxes should be insisted upon, and the proposals made more rigid in other directions. Mr. H. J. Cash said that although he agreed with Mr. Foggo, the Register had to move slowly and cautiously. They had to carry with them supply authorities, manufacturers and others who were determined to push electricity at all costs, and they could not make the prices of installations prohibitive. Mr. Calvert pointed out that the Executive asked for approval to the principle behind the proposals; they could always be strengthened later on. In the course of a protracter discussion in which Messrs. W. H. Walton, W. R. Rawlings, H. J. Cash, R. A. Ure, P. V. Hunter, and A. H. Dykes took part, Mr. Purse suggested an addition providing for proper jointing and the protection of joints in cables and flexibles, and enjoining the use of mechanical connectors and suitable joint boxes. It was eventually decided to give the Executive Committee powers to circulate the document as put forward, with the certificate renewal notices. Messrs. Hunter, Dykes and Cash, the retiring members, were re-elected to the Executive Committee.

Mr. W. R. Rawlings mentioned that arrangements were being made to relieve Mr. Trimnell, the secretary, from some of his work, but said that the Register would continue to have the benefit of his advice and assistance. A number of members paid a tribute to Mr. Trimnell's work for the Register. Mr. W. A. Shaw asked the Executive to send copies of the approved draft regarding bad workmanship to all supply authorities, and the meeting concluded with a vote of thanks to the chairman.

The Annual Report.

In its report for the past year the Executive Committee of the Register draws attention to the increased expenditure upon advertising and publicity literature, &c. The item specified includes part of the sum of £400 allocated for the purpose which was spent on advertisements in the electrical, architectural, municipal and building journals, the printing and circulation of lists of registered contractors, pamphlets, &c. An item "legal expenses" in the accounts relates to costs incurred in connection with the obtaining of an injunction against a firm of contractors who had improperly used the device of the Register granted to their predecessor before their application had been adjudicated upon by the Executive Committee. A larger office has been taken in the same building.

During the year 257 applications for registration were received; of these 124 were accepted and 39 declined and withdrawn, while 94 were under consideration at the date of the report. The total number of applications received up to December 31st, 1928, was 1,584, and the net number of contractors on the Register at that date was 1,150, representing an increase of 101 during the year.

To those authorities who had already confined installation work under assisted wiring schemes to registered contractors, the following names were added during the year:—Birmingham, Leeds, Oldham and Plymouth. For some unexplained reason South Shields rescinded its previous decision to give such work only to registered contractors. The Committee considers that the grant for publicity has been well expended and made to go a long way. A reprint of an article by Mr. H. Moss on "The Need for Compulsory Registration" has been circulated to the number of 15,000, and contractors have applied for 100,000 copies of the pamphlet entitled "Hidden Risks." Advertisements have appeared at regular intervals in the electrical and other specialised Press, and many encouraging editorials and notices have appeared in those papers and in the daily Press, bringing the Register and its objects before the public. A large number of inquiries have resulted, coming not only from the United Kingdom but also India, Australia, the United States, &c.

At the last annual meeting it was stated that the representatives of the Electrical Contractors' Association on the local advisory committees were not always registered contractors, and it was resolved that the matter should be discussed with the E.C.A. to remedy this. As a result of a joint conference it was agreed that where the E.C.A. was unable to appoint a registered contractor member to a local advisory committee, the representative appointed should be required to become registered within twelve months or cease to be eligible as a member of the advisory committee. Discussions with the E.C.A. regarding certain of the rules and conditions of registration had led to the Association's agreeing to submit proposals in writing to the Register. To enable the Association to gain a better insight into the work of the Register, the President has been invited to attend the Committee's metings.

The Committee is still of opinion that the time has not yet arrived for making wiring regulations compulsory. Recent events, however, have proved the necessity for some provision for bringing under the ban of the National Register certain unsatisfactory features in installation work, and Mr. Cash, at the request of the Committee, has prepared a list of examples of faulty wiring work which it is recommended shall be the basis of a regulation or standing order, and the employment by a contractor of such methods shall be cogent reasons for the exercise by the Committee of the disciplinary powers conferred upon it. Recently a report upon an application for registration by a certain local advisory committee disclosed such a difference of opinion, that it was necessary for a member of the Committee to interview both the advisory committee and the applicants. Mr. Cash found that it appeared to be a practice in the locality to carry out wiring work in a manner that conflicted with the proposed regulation. The applicants were required as a condition precedent to the acceptance of their application to alter the installations in question and to undertake to avoid repetition of such methods in the future. The attention of the supply authority was also drawn to the matter, with the result that all contractors in the area, whether registered or not, have been forbidden to adopt the methods in question. The Executive Committee claims this as a considerable step in the direction of achieving one of the objects of the Register—the improvement and standardisation of electrical installation work. The seventeen London area advisory committees had now been practically filled and are now operating. With one or two exceptions the work of all local advisory committees has proceeded smoothly and with reasonable dispatch. The Committee expresses its appreciation of the activities of these bodies, and of Messrs. Cash and Purse, the Scrutinising Committee.

Complaints of bad workmanship against two firms were lodged during the year. In one case the report of a consulting engineer fully substantiated the complaint made, and in the absence of an adequate explanation the certificate of the contractors concerned was cancelled. In the other case, bad work was admitted but extenuating circumstances were pleaded. As a condition of remaining on the Register the contractor was required to make good the work in connection with which the complaint was made and any similar work carried out by him, and to give a satisfactory undertaking with regard to future work. Complaint was made against another registered contractor for employing an undue proportion of boy labour and paying inadequate wages. The contractor appeared before the Committee and promised to increase wages to a satisfactory rate. Subsequently he declined to carry out his undertaking, and accordingly his certificate was cancelled.

The only alterations in representation on the Registration Board are in the case of the I.M.E.A. which has nominated Mr. W. A. Walker in the place of Mr. C. H. Smyth; and the E.C.A. of Scotland whose president, Mr. J. J. Foggo, takes the place of the retiring president, Mr. Ure.

Porcelain Insulator Tests.

A consideration of the design, or type, tests for determining the characteristics of the insulator and its suitability for the service specified.

By B. L. GOODLET, A.M.I.E.E.

(Extracts from a paper read before the Institution of Electrical Engineers.)

THE general viewpoint of the various national specifications is much the same, the major tests differing from each other only in details of execution. All the specifications group the tests required under the following two heads :—(*a*) Design, or type, tests, the object of which is to determine the characteristics of the insulator and its suitability for the service specified; (*b*) routine or manufacturers' tests, the object of which is to detect manufacturing defects.

All the national insulator specifications have as their basis the following fundamental requirements :—

(1) The mechanical strength of the insulator must be sufficient for the purpose in hand.
(2) The puncture voltage of the insulator must exceed its spark-over voltage under all conditions of climate and load.
(3) The insulator must be completely non-porous.
(4) The insulator must withstand sudden fluctuations of temperature over a limited range.

Corresponding to these fundamental requirements are the following basic tests :—

Electrical.	*Mechanical.*
Dry spark-over voltage.	Puncture voltage.
Wet spark-over voltage.	Strength.
	Temperature cycle.
	Porosity.*

In addition, special tests are frequently included.

Minor alterations in the arrangement of all the details of the set-up are capable of producing appreciable results; successive tests even on the same insulator are never likely to be made under precisely the same conditions, and hence it is unreasonable to expect perfect coincidence of figures.

The barometric correction is important when insulators are to be used in mountainous regions; the temperature correction must be remembered when insulators are to be used in hot climates or situations. It does not appear to be known generally that an increase in humidity raises the spark-over voltage of most insulators, particularly large ones. A voltage increase of 15 per cent. is quite usual for a humidity increase of from 50 to 90 per cent. Above 90 per cent. relative humidity the spark-over voltage generally begins to fall; the actual precipitation of moisture on the insulator surface lowers the spark-over voltage. For this reason the spark-over voltage of an insulator should never be measured immediately the insulator has been brought in from outside or otherwise moved from a cold to a warm locality. In such cases sweating invariably occurs and the results, apart from being erratic, may be appreciably lower than would be obtained with the insulator clean and dry, which raises the question of the influence of surface films in general.

Frequently insulator hardware has a coating of soluble impurities remaining from the galvanising bath, and traces of crystalline salt are sometimes to be found (a relic of the water-bath test); as both these impurities are dissolved by rain water, its resistivity is lowered and low values are obtained until the coatings have been more or less removed. The presence of this kind of effect may often be detected by comparing the resistivity of the water falling on and flowing off the insulator, and the influence of the water resistivity on the results of wet spark-over tests is obviously much too great to disregard. It has sometimes been proposed that it should be permissible to test with water of any resistivity, the spark-over values being then reduced to a standard resistivity by multiplication by a correction factor. However, apart from the fact that these factors are not the same for different types of insulator, with water of various resistivities, there is a physical difference in the phenomena involved which cannot be adequately taken into account by a mere numerical ratio.

Consider now the electrical performance of fouled insulators. The experimental procedure best calculated to exhibit the effect of such deposits is to observe the discharge and spark-over voltages of the insulator as a function of the relative humidity of the air for various thicknesses of deposit.

Fig. 1 shows the influence of various intensities of salt deposit on the power-frequency spark-over voltage of a 3-unit chain of cap-and-pin type insulators, such as is frequently used on 33-kV lines; the relative intensity of the deposit is expressed by the weight (mg/cm²) of precipitate. The combined action of a heavy salt film and damp atmosphere is capable of reducing the actual spark-over voltage to less than 30 per cent. of its nominal value. The performance of an insulator in the fouled condition cannot be characterised solely on the basis of its spark-over voltage. Usually, luminous discharges are present at very much lower voltage and, with certain types of insulators, at the higher humidities these discharges assume the form of partial arcs between the sheds, developing considerable heat and noise, but without causing an actual arc-over. The action of such discharges, if prolonged, is very damaging to the surface and glaze of the insulator.

Another point of interest is that the spark-over voltage at 95 per cent. humidity is frequently lower than in actual fog or rain. The impulse spark-over is practically unaffected by fouling.

The phenomena observed with substances other than salt and soot are qualitatively very similar; of all the impurities tested,

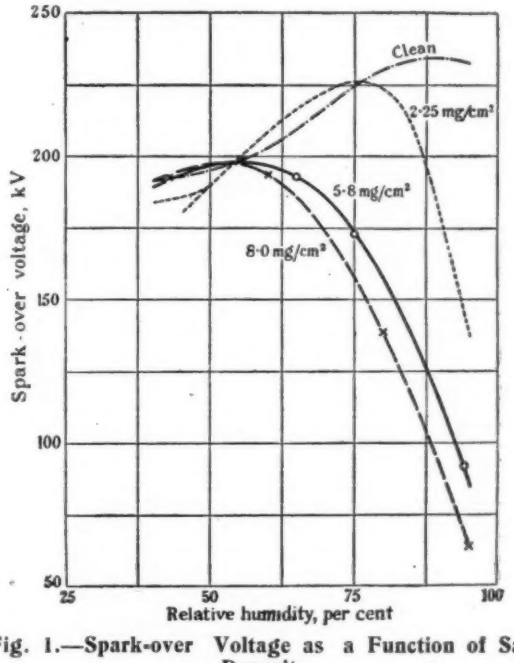


Fig. 1.—Spark-over Voltage as a Function of Salt Deposit.

those of a metallic nature, such as metallurgical fumes, had the most deleterious influence; cement dust is also extremely harmful, the spark-over voltage frequently being reduced to 10 per cent. or so of its nominal value.

The fouling trouble has given rise to a considerable amount of thought among insulator designers, and there are at present on the market several designs for which especially good performance in damp and polluted atmospheres is claimed. The majority depend for their effectiveness upon the presence of a long and protected leakage line obtained by the use of deep vertical surfaces. A rational criterion on which the probable performance of an insulator in the foul condition may be estimated is provided by the following consideration.

If a moist deposit is formed on the surface of a dielectric under stress, then the tangential component of intensity over that surface will tend to vanish to an extent dependent upon the conductivity of the surface film, and in the limit an equipotential surface will be established. *The minimum disturbance of the original field form will therefore occur with an insulator on which the deposits accumulate mainly on surfaces which are equipotential surfaces also in the clean condition.* Fig. 2 shows the field forms determined by experiment on the 3-unit suspension insulator chain previously mentioned, in the clean and foul conditions. The vanishing of the tangential component of intensity over fouled surfaces is well illustrated, the majority of the lines of force cutting the fouled surfaces strictly at right angles.

In studying the matter from this aspect, however, it must not be forgotten that the field form of an insulator is liable to

* Omitted from the American I.E.E. Specification.

alter with voltage and other factors, so that conclusions on this basis can be drawn only with great caution. From the above remarks it will be apparent that the satisfactory execution of fog tests calls for great care and much knowledge of a nature not usually to be found in an engineering test room. For these reasons it may be doubted if a fog test can be developed which will give satisfactory results in commercial work.

In the selection of high-voltage insulators, engineers at the present time are guided mainly by the principles implicitly, or explicitly, laid down in the various national insulator specifications. Since innumerable networks equipped with insulators selected on this basis are giving fairly satisfactory service, it is obvious that the governing ideas of the specification cannot be unsound. It is, however, necessary to realise that the requirements of the national specifications are in general the absolute minimum which can be demanded from an insulator. An insulator which does not comply with these requirements is practically certain to be unsatisfactory in service, but the converse proposition is by no means the case; therefore, the present specifications are in general a little incomplete. To see the direction in which improvements could be effected it is necessary to examine briefly the origins of our present service troubles.

Insulator troubles in transmission systems are invariably due to one or other of the following causes:—

(1) Excessive voltages, which may be classified from their origin as (*a*) power-frequency surges due, say, to sudden dropping of load; (*b*) switching surges and arcing earths; (*c*) lightning surges.

Operating experience indicates that in systems insulated in accordance with modern practice (with earthed neutral) light-

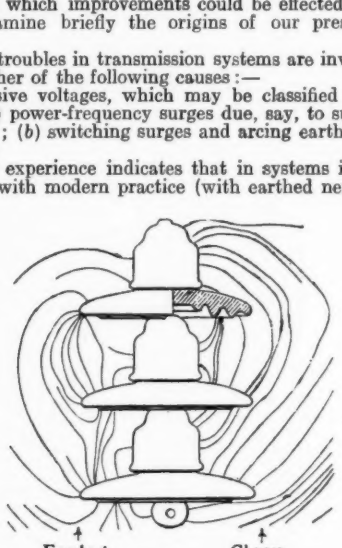


Fig. 2.—Insulator Field Form.

ning is the only source of over-voltage requiring serious consideration. The voltages induced by lightning in the line itself are of an impulsive nature, but by reflection from terminal apparatus oscillatory voltages may be built up. We may therefore conclude that from the over-voltage standpoint the impulse and high-frequency characteristics of the insulator are of the first importance.

The over-voltage problem has given rise to a considerable amount of discussion as to the grading of the insulation strength in various parts of a transmission system. The generally accepted view seems to be that a short section of line immediately adjacent to a station should be more lightly insulated than any other portion of the system, with a view to localising troubles at a point convenient for repairs. The insulation of the station apparatus may either increase continuously from the incoming line to the main transformers, or the relative strength may be graded on a basis designed to attain minimum number of interruptions, minimum cost of repairs or some similar objective.

The advantages to be gained by the adoption of some such scheme undoubtedly appear to be very great, but the basis of classification to be adopted requires very careful consideration. The present tendency is to argue that as lightning trouble is the principal reason for any such system being desirable, the lightning, or impulse, spark-over and puncture voltages of the component parts should be made the basis of the grading. Classification on such a basis obviously requires the standardisation of methods of carrying out the impulse test, particularly with regard to the wave-form of the impulse adopted. To the question of what this standard wave-shape should be the obvious answer is that it should approach as closely as possible to that of the disturbances produced by actual lightning. This reasoning is certainly very plausible and convincing so far as it goes, but to the author it appears to neglect two most important facts.

In the first place, it seems to be tacitly assumed that a "standard" lightning surge does in fact exist, *i.e.*, that all lightning discharges are similar and give rise to impulses of similar wave-shape in the lines. In the second place, the distortion of the lightning impulse during its passage through the terminal apparatus is neglected. The wave-shape of an impulse arriving at the station from the line may be perfectly well known and simple. By the time, however, that it has traversed the various choke coils, isolators, oil switches, current transformers and other impedimenta which station engineers seem to find necessary, we may be quite certain that its form will be only remotely similar to that of the incident wave. Indeed, it seems to be fairly certain that the voltages developed at the main transformer terminals are frequently oscillatory and not impulsive in nature. Further investigation may certainly prove that the characteristics of the dangerous disturbances are sufficiently definite to enable imitative tests to be standardised. Until such evidence is to hand, however, it would be very unwise to make any far-reaching alteration in the specifications such as the classification and rating of insulators on the basis of impulse performance would involve.

(2) A reduction in the insulation strength of a system, which becomes manifest either as (*a*) a reduced spark-over voltage, or (*b*) a reduced puncture voltage. (*a*) Reduction may be caused either by adverse surface conditions (rain, fouling) or by damage of a mechanical nature such as fracture of the sheds. As the impulse and high-frequency spark-over voltages are unaltered by rain and fouling, surface conditions become important only when the magnitude of the reduction is so great that the normal operating voltage can start trouble. With systems insulated in accordance with present practice a reduction of such magnitude can be effected only by fouling. The study of the phenomena on fouled insulators has therefore considerable practical importance, particularly for engineers whose lines run through industrial or coastal districts. (*b*) Reduction almost invariably has its origin in some mechanical trouble, if we except the cumulative damage done by repeated impulses; such are excessive electro-mechanical loading, swelling of cement, growth of metal parts by corrosion, sudden temperature-changes and similar phenomena for which it is difficult to devise satisfactory tests. Impulse and electro-mechanical tests will probably be suggested as a cure for this trouble in the future, but it is by no means certain that this is the correct line of approach.

(3) Mechanical failures, which occasionally occur due to abnormal operating conditions, but are far more frequently to be traced to faulty design, or defective manufacture, of the insulators themselves. The more obvious constructional defects giving rise to a low ultimate strength are adequately looked after by the ordinary mechanical load test, but there are a number of other points, particularly relating to the transmission of load between the conductor clamp and the porcelain, which require serious consideration. In this connection it is probable that vibration and shock tests, and tests with fluctuating loads, will find an increasing application in the future.

Summarising the above remarks, it must be admitted that there are many phenomena affecting the service performance of insulators about which the tests called for in the various standard specifications provide us with little information. Some alteration in these specifications appears, therefore, very desirable. It must, however, be realised that it is neither possible nor desirable to devise tests which will cater for every possible source of trouble. Matters are seldom so simple that a crude test described in a 4-page specification will enable a casual inspector to determine facts which specialists may not be certain of. In particular the specification of "freak" tests by individual purchasers is to be deprecated. Such tests merely waste the time of precisely those individuals who are in the best position to effect advances in our knowledge of the subject.

It should be recognised that the best guarantee of a reasonably prolonged life for an insulator is the assurance that the manufacturers have themselves devoted intensive thought to their problems and run both their engineering and manufacturing departments under strict scientific control.

The foregoing paper is the result of experience gained in the research laboratories of the Metropolitan-Vickers Electrical Co., Ltd.

Discussion in London.

Mr. S. W. Melsom said the paper was timely, but it was unfortunate that the author had confined himself to tests, as an indication of how to design insulators was needed. The tests were not always made under practical conditions and they were therefore in a false position; that fact had been responsible for trouble in the past. Who could say what the resistivity of actual rain water was? However, the Research Association was working hard in collaboration with the author and his associates. The fouling conditions were not properly realised, and users had escaped trouble in the past because they had been using bigger insulators than the specifications called for. Exposure to rain did not keep insulators clean: observation in South Wales had shown that salt floated in the wind in a dry state, was deposited on insulators, and after being moistened by dew would adhere tenaciously in crystal form even after much rain. He could not appreciate the suggestion to provide "weak links," as lightning was not so obliging as to go to earth where one would like it to. What was wrong with spark-gaps? He would prefer them with hard insulation all along the line. When they were able to plot the voltage distribution over an insulator surface satisfactorily they would solve many of their problems.

Mr. C. W. Marshall explained that in the national specifications an attempt had been made to simulate practical conditions. Britain had been very much behind in providing suitable testing apparatus anywhere. The power-arc test was very informative, but was not yet available in England. Most people favoured the provision of guard rings, but opinion in America was somewhat contrary.

Mr. N. E. P. Harris thought those who had been responsible for insulator design must have been very slow, for it was remarkable to recall how long ago statements had been made which foretold that which was happening to-day. He endorsed the author's remarks on resistivity relative to the correction of the water rather than of the test results. The

I.E.E. rules were based on variation and that factor only, because variation was considered to be worse than anything else. Manufacturers' greatest enemy was the man who did the work and the process through which the materials went, not heating and cooling in the fire as the author seemed to think. Regarding the author's remarks on equipotential surfaces, the most critical condition was when the surfaces were wet and the criterion was the length and efficiency of those surfaces.

Mr. W. A. Coates remarked that if the paper resulted in the establishment of standard methods of testing, then it would be the most important they had had for many years. He mentioned tests which were undesirable at present because methods of reproducing them were undefined. By using guard rings on the "grid" the Central Board was leading the way; horns were practical, but the author's lantern slides might be misunderstood, for in practice they would not guarantee that the arc would keep away from the porcelain. The author's work on fouled insulators had been of extraordinary value and might lead to a demand for insulators that would stand up to foul conditions, though their design was not practicable yet. He suggested that the B.E.S.A. should form a committee of the three or four men who were really skilled in the technique of the high-voltage laboratory to frame agreed conditions of test; by the time it had done that it might be in a position to classify atmospheres and specify insulators for each of them.

Mr. R. W. Todd pointed out that large contracts called for from 5 to 10 per cent. to be type tested; that was too large and a saving could be made without sacrificing efficiency. Did it matter if the dry flash-over figures fluctuated, so long as they did not exceed the wet test figures, which were the lowest and on which the safety factor was based? In addition to the duties suggested by the previous speaker, his proposed committee should consider all the tests now considered necessary and put them on a definite basis.

Mr. W. A. Erlebach, in referring to the inaccuracy of various tests, thought that too many string tests were made; one should suffice for the whole order, and more attention should be concentrated on making individual units alike. He recommended the over-potential test, the third of the American tests, as being quite conclusive.

Mr. W. Wilson thought the author dismissed porosity too lightly. He knew of a 70-mile 66-kV line on which pin insulators made by a number of experienced manufacturers were used, on which over 40 break downs per year had been experienced. Investigation traced the trouble to porosity, which could not be detected except by the long application of a h.p. test, say 2,000 lb. for 100 hours.

Mr. J. F. Shirley contended that manufacturers thought they knew how to pack insulators for export, but they did not. He knew of many cases of insulators which had passed tests in England having to be replaced when they reached the other end of the world.

Mr. W. Holttum suggested painting insulators to simulate deposit on them for test purposes. It was insufficient to assume that porcelain was not porous, and a test should be applied to prove it. Greater use might be made of arc rings to drain off stress at the end.

Mr. B. L. Goodlet, in reply, said that they only attempted to simulate in the laboratory what happened in service; they could not reproduce the same conditions. He exhibited a sample of porcelain which he claimed to be not porous in any way.

A Conference on Chromium Plating.

A Report of a Recent Provincial Meeting of the Electroplaters' and Depositors' Technical Society.

A RECENT meeting of the Electroplaters' and Depositors' Technical Society at Birmingham took the form of a conference on chromium plating. Mr. S. Field, president, occupied the chair, and there was a very good attendance of both London and provincial members.

Mr. G. E. Gardam, B.Sc., A.R.C.S., opened the conference with an appropriate paper entitled "A Survey of the Published Information on Chromium Plating," and a very animated discussion followed the reading of the paper, which is reported below.

Survey of Chromium Plating.

Although a certain amount of information on chromium plating was previously available, development of the commercial deposition of chromium on the present scale was principally due to the work of Sargent, published in 1920. The two chemicals forming the essential basis of a chromium depositing solution were shown by him to be chromic acid (CrO_3) and chromic sulphate. Subsequent investigations, however, demonstrated that, whereas the addition of some second substance to the chromic acid is imperative, it is not necessary to employ chromic sulphate, and that sulphuric acid, or certain other acids, or their salts, will give satisfactory results; owing to the fact that sulphuric acid may be readily obtained in a state of high purity, coupled with the fact that sulphates are a common impurity in chromic acid, it is commonly found convenient to use this acid as the second essential chemical in chromium-plating solutions.

The concentration of sulphuric acid in the solution is of considerable importance, and it must bear a fixed relationship to the chromic-acid content. For average working conditions one part by weight of sulphuric acid should be added for every hundred parts of chromic acid present in the solution. If the proportion of sulphuric acid is lower or higher than the above values, there will be a tendency for the cathode efficiency to be reduced, so much so that in the absence of sulphuric acid from the solution, or in the presence of a considerably greater proportion than that stated above, little or no deposit will be obtained. A further detrimental effect caused by too-low a concentration of sulphuric acid is the production of deposits covered with a brownish film.

It has been found possible to produce deposits of chromium from solutions containing as little as 100 gm. and as much as 600 gm. of chromic acid per litre, but for general purposes most workers prefer a bath of moderate concentration, of which the following composition is typical:—

	Gm. per litre.	Oz. per Imperial gallon.
Chromic acid (CrO_3)	250	40
Sulphuric acid	2.5	0.4

No other added substances are essential for satisfactory working, but it is evident from the change of colour of the solution which takes place, and also from chemical analysis, that certain chemical changes occur during electrolysis. The most important of them is the reduction of a portion of the hexavalent chromium to the trivalent state. Some workers have, therefore, favoured the deliberate initial reduction of part of the hexavalent chromium to the trivalent state by chemical, or electro-chemical means, or the addition of compounds of trivalent chromium, such as the hydroxide or carbonate. The presence of trivalent chromium in a chromium-plating solution is probably essential if good results are to be obtained, and baths which are working satisfactorily usually contain up to 2 per cent. of this substance. It is, however, important for a number of reasons that the concentration of trivalent chromium in the solution should be limited. It has been shown, for example, by Haring and Barrows and Schneidewind and his co-workers that the presence of considerable quantities of trivalent chromium greatly reduces the range of current densities in which satisfactory deposits can be obtained.

In spite of the fact that excellent results may be obtained from a solution made up from chromic acid and sulphuric acid alone, a large number of other substances have been patented as offering advantage when added to chromium depositing solutions. Such additions fall into two classes: (*a*) additions of such substances as chlorides, fluorides, borates, phosphates in place of, or auxiliary to, the usual sulphate additions, and (*b*) additions of salts, usually hydroxides or carbonates, of such metals as nickel, zinc, copper, the heavy and alkaline earth metals, as well as chromium. From a critical examination of chromium-plating patents, Schneidewind has drawn the conclusion that no fundamental improvement is obtained by such additions as those referred to above.

Operating Conditions.

The most striking features in which chromium plating differs from most other metal-deposition processes are the high current density necessary, the low current efficiency obtained, and the pronounced differences in the character of the deposit that result from variations of the current density, temperature, and composition of the solution. In general, with increasing current density, or decreasing temperature, the efficiency increases, and the appearance of the deposit changes from a bluish coloured deposit having a bright matte surface to one with a bright lustrous appearance, and finally to a dark-coloured iridescent deposit often described as "burnt." The bluish deposit with a bright matte surface is usually extremely thin and of no commercial value. The bright lustrous deposit is extremely hard and decorative, and needs little or no subsequent polishing. The dark matte deposit is obtained at much higher efficiency than the bright lustrous coating and, though still extremely hard, can be polished by the usual methods. The resulting plate is somewhat darker than the coating deposited in the bright condition.

The balance of current density and temperature necessary in a given solution to obtain the bright lustrous deposit is very sharply defined and, moreover, varies with the nature of the cathode metal. A considerable amount of data has been empirically accumulated on the optimum average current-density range in which a bright deposit may be produced. It is desirable that the range should be as wide as possible

for at least three reasons: first, because it is often difficult to estimate the area of objects to be plated, and in such cases the current density cannot be calculated with any exactitude; and, secondly, because in the case of the large majority of articles that are chromium plated the current density cannot be calculated with any exactitude; thirdly, because in the case of the large majority of articles that are chromium plated, the current density varies from one part of the surface to another, being relatively high on projecting parts and low on recessed portions. The desired end is best achieved if:

(1) A solution of chromic and sulphuric acid in the ratio, and approximately in the concentration already suggested, is used.
(2) The bath is kept as free as possible of trivalent chromium.
(3) The current density is moderately high (*i.e.*, from 100 to 300 amps. per sq. ft.).
(4) The surface of the cathode is formed of a metal of high hydrogen over-voltage (such as copper).

Influence of the Cathode Metal.

The nature of the cathode material, in particular its hydrogen over-voltage, is an important factor in determining, not only the character of the initial deposit of chromium, but also the ease with which the cathode may be covered with the deposit. In the case of metals of low hydrogen over-voltage, such as iron and steel, the minimum current density at which chromium can be deposited is higher than, and the range of current densities in which bright deposits may be produced is both different from and more restricted than in the case of metals of high hydrogen over-voltage, such as copper. Once the cathode is completely covered with a coating of chromium, by virtue of its own hydrogen over-voltage, it demands its own particular range of current densities for the continuance of a bright deposit. The over-voltage of chromium being fairly high, the current-density range will only be the same as the "striking" range if the over-voltage of the basis metal is fairly high. It is often desirable, therefore, to coat a metal of low hydrogen over-voltage, such as steel, with a metal of higher hydrogen over-voltage, such as copper, before proceeding to deposit chromium upon it. As nickel has a lower hydrogen over-voltage than copper, it is thus not so satisfactory in this respect, but an undercoat of nickel has much to recommend it from the corrosion standpoint, and it is now common practice to deposit a layer of this metal on steel articles prior to chromium plating.

Anodes.

Lead anodes are very satisfactory, though they are slowly attacked by chromic-acid solutions, forming insoluble lead chromate, which, however, has no detrimental action on the bath. Lead of high purity is necessary, impurities, particularly antimony, greatly increasing the rate of attack. If sufficiently large, lead anodes tend to cause reoxidation of trivalent chromium by virtue of their high oxygen over-voltage, and for this reason it is recommended that the area of lead anodes should be at least twice that of the cathode. One disadvantage of lead anodes, however, is that in course of time an adherent coating of high resistance tends to form upon them, causing, if complete, a high bath voltage. If the coating is not complete, but occurs in patches, its presence is not so easily detectable and it may cause uneven current distribution and patchy deposits. A method of removing this non-conducting coating of lead chromate that involves less labour than scouring consists in submitting the anodes to the action of a saturated solution of sodium chloride acidulated with hydrochloric acid, which readily dissolves it.

Properties and Applications.

Electrodeposited chromium is especially distinguished from other metals by (i) its resistance to atmospheric and other corrosion, (ii) its resistance to oxidation and corrosion at elevated temperature, and (iii) its extreme hardness and low coefficient of friction. As deposited in the bright condition, chromium has a bright, lustrous metallic surface with a slightly blue colour. The reflectivity is only 65 per cent., but, in contrast with other metals, this figure is permanently maintained as the chromium is apparently quite unattacked by the atmosphere, even at temperatures as high as 300 deg. C., and also by salt water salt spray, ammonia, nitric acid and hydrogen sulphide. Dilute sulphuric acid and hydrochloric acid vigorously attack the metal only if it is first rendered "active" by cathodic polarisation, *e.g.*, by contact with a piece of zinc also immersed in the acid.

The commercial applications of chromium plating are, of course, too numerous for each to be mentioned. Among the more important applications of the thinner types of deposits, however, are the plating of plumbing fixtures, cheap jewellery and motor-car fittings. The latter in some cases have not apparently given such good service as was hoped, probably owing to the fact that the chromium was deposited directly on to brass. Nevertheless, the standardisation of chromium plating on certain makes of car forecast considerable popularity in the future. Some firms have installed completely automatic chromium-plating plant.

Advantage has been taken of the high resistance to wear possessed by chromium deposits in such applications as the facing of gramophone-record matrices, steel plug gauges, and printing plates, and it has been found that such parts are serviceable for from four to ten times as long when they are faced with a thin deposit of chromium. Chromium-plated valves for steam and internal-combustion engines withstand the action of hot gases better than similar unplated parts. Reflectors have been successfully plated with chromium, the untarnishable and unscratchable nature of the surface compensating to a large extent for the low reflecting power.

The low coefficient of friction which chromium possesses makes it a suitable metal with which to coat bearings, machine parts, and cams Rolls for paper finishing and glass-sheet manufacture have a longer life when chromium plated; plating has also been successfully applied in the case of moulds used for the manufacture of glass bottles, synthetic resin and vulcanised-rubber articles, as it provides a surface to which the material shows no tendency to adhere. Chromium-plated die-casting and ingot moulds also withstand the solvent action of the molten metal to a considerable extent. Certain parts of chemical plant used in paper making and petroleum refining plants have been plated with chromium, and the treatment has proved very successful.

Discussion.

Opening the discussion, the president (Mr. S. Field) said there was still a considerable amount of doubt regarding the nature of the trivalent chromium present in the solution, and the extent to which it was combined with the chromic acid. The latter was also combined with iron which entered the solution. In one case of a poorly working solution, it was found that the trivalent chromium and iron content accounted for the whole of the chromic acid in the solution!

Mr. E. A. Ollard said failure in the early days was due to non-attention to details, *e.g.*, solutions with as much as 20 per cent. sulphate were used. Solutions containing fluorides were easier to control. Adding sulphate to allow for "drag" was not to be recommended, since it might be difficult to get rid of later. The amount of sulphate present should depend on the dichromate content. Satisfactory results were not obtained by analysing for hexavalent and trivalent chromium. The solution could be readily controlled by periodic determination of the specific gravity and the conductivity.

Mr. L. Wright said the deposit usually aimed at was the bright one, but he had obtained the matte deposit on both laboratory and commercial scale, and these could be highly polished subsequently. These deposits were obtained from a bath having a chromic dichromate content which was deemed to be unworkable by the Americans, Haring and Barrow. The working range of a bath was determined by the ratio of chromium to hydrogen, not chromic acid to sulphuric acid.

Mr. A. E. Boulter asked if chromium could be deposited in a more or less ductile form to withstand vibration, as required when deposited, for example, on gramophone needles. Also, would the deposit retain a cutting edge or fine point indefinitely?

Mr. J. W. Perring asked for an approximate estimate of the overall efficiency of a chromic-acid plant in B.O.T. units per gram of metal deposited, taking into account the electrode efficiency, motor-generator efficiency and power required for the fan.

Mr. L. G. Roberts said he had found it possible to obtain very satisfactory results without having to remove the anodes periodically. He used a large anode surface, about half the side of the vat in area. He urged the younger platers desirous of making a success of chromium plating to spend a part of their time in studying the theoretical aspects of the problem.

Mr. S. Wernick said that the big problem of throwing power had been largely overcome in the last two years, but still chromium-plating practice was very much ahead of theory. There was uncertainty in regard to the effect of constituents other than those which were essential, thus, iron was said to be beneficial in producing a brighter deposit, but was detrimental since it decreased the conductivity and throwing power. Since ferrous containers were used to a large extent, it was important to know what limit was allowable. For theoretical reasons, nickel was better than copper as an underlay, resulting in a higher throwing power.

Mr. E. J. Dobbs said his experience was that determination of chromate content was a difficult matter—he could get within one gram per litre, but sulphate content could be obtained within 0.01 gram per litre. In analysing, he added alcohol to the chromic-acid solution until no further action occurred, then sufficient hydrochloric acid for all the chromium present, leaving a slight excess. The solution was then boiled to remove aldehydes present, and precipitated with barium chloride, allowing it to simmer for some hours before filtering. This avoided carrying down any green chromic acid with the precipitate.

Mr. D. J. Macnaughtan, in an eloquent address, urged that there should be the closest co-operation possible between the practical plater and the plating chemist, this being one of the foremost aims of the Society. He was supported by Mr. R. A. F. Hammond, who said that platers could best co-operate by using their powers of observation and communicating their findings to the scientific investigators, since often the most apparently irrelevant phenomena provided clues which were of the utmost value to the chemist in solving difficulties.

The Author replied to the discussion, and it was suggested that the next provincial conference of the Society be held in Glasgow.

KVA-Demand Measurement.

Technical considerations concerning the definition and calculation of power factor in relation to tariffs.

By E. W. HILL.

(*Abstract of a paper read before the* Meter and Instrument Section *of the* Institution of Electrical Engineers.)

Special tariffs have been devised, and in many cases accepted, with a view to encouraging consumers to adopt power-factor improvement methods, and various kinds of instruments have been invented for the purpose of measuring the fundamental quantities (power factor, kVA and kVA-hours) upon which these special tariffs are based. Under certain conditions the use of these terms involves ambiguity, unless the terms are explicitly defined, since more than one definition of them is possible. The measuring instrument employed is chosen, apparently, not in order to conform to a predetermined definition of the quantities, but, on the contrary, the definition is allowed to depend on the choice of instrument, and in that respect the definition is a matter of hazard rather than of conscious selection. Such a condition of things is hardly defensible, since it will be seen that it is possible for large sums to be at stake on the choice, for example, of kVA definition.

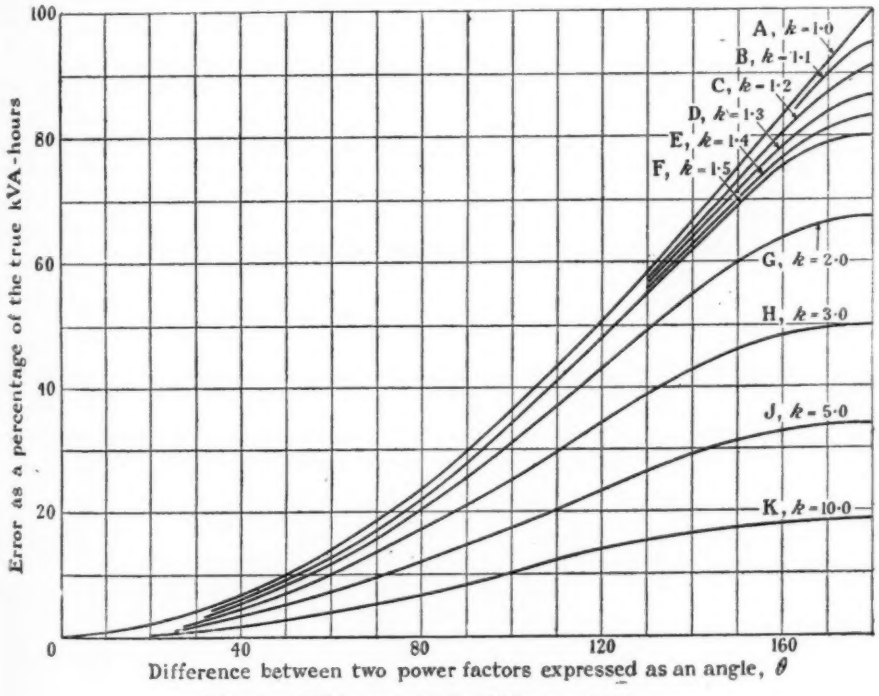


Fig. 1.—KVA-error-Angle Difference Curves.

The first ambiguity centres round the definition of power factor in a 3-phase system. Two definitions stand out as being reasonably acceptable to engineers, both of which are based upon analogy from the definition of power factor in single-phase systems, in that they state 3-phase power factor under steady conditions to be the ratio between the total 3-phase watts and the total 3-phase volt-amperes. The total 3-phase watts is a definite physical quantity, without ambiguity, but the total 3-phase volt-amperes is not; and the two definitions of the 3-phase power factor depend upon two corresponding definitions of 3-phase volt-amperes, which are usually known as: (i) the vector-sum definition, and (ii) the arithmetic-sum definition.

The results of the two definitions can only agree if the phase-displacement angles are all equal and are all lagging or all leading. It is claimed that (i) is by far the better definition, upon the grounds that it is free from ambiguity; that it gives results dependent only upon the character of the load, and not upon the way it is applied to the lines; and that the results are the same however and wherever in the system the measurement is made. Although the arithmetic-sum definition on the other hand lacks the support of almost every one of these attributes, yet it has points to commend it to the clear disadvantage of definition (i) in relation to its suitability as a basis for a tariff. The arithmetic-sum definition is not susceptible of completely general application in a scientific sense to all polyphase systems; in order to be quite definite it depends upon the employment of the three star-leg voltages; and its results depend also upon the way in which a set of loads are applied to the 3-phase lines, as well as upon the character of the loads. The last, however, far from being a defect, is a positive virtue in relation to tariffs.

To be of any use, a "power-factor taiff" should be founded upon a technical basis which gives effect to the principle that a consumer should be penalised for demanding more than the minimum current necessary for a given power consumption.

The discrepancy between the two definitions may have an important practical bearing in relation to such instruments as power-factor indicators. There are many of these constructed for 3-phase unbalanced loads, and it is very doubtful indeed whether any one of them bears an explicit indication as to the particular definition of unbalanced 3-phase power factor to which it is supposed to conform. It appears that the definition of apparent power in a 3-phase system is involved with the question of unbalanced loads. This question also leads to another matter requiring consideration. With unbalanced loading it may happen that the maximum volt-ampere demands on the individual lines are not coincident. On the contrary, there may be a diversity of incidence, such, for example, as would be illustrated by loads of 2, 1 and 1 amperes, respectively, in lines R, W and B at a certain time; while later the loads may have altered to 1, 1 and 2 A, respectively, and again still later to 1, 2 and 1. The conclusion to be drawn from this is that where there is serious unbalance of loading it might be advisable to base a tariff, not upon the simultaneous combined demand on the three lines, but upon the highest one of the three demands on the individual lines, multiplied by three. Even without diversity of incidence this might still be advisable, because 3-phase cables and other apparatus must necessarily be constructed with three conductors of *equal* capacity, the capacity being that of the highest demand on any one conductor.

There are also ambiguities possible in relation to systems in which the power factor does vary, and under such conditions it is frequently desirable to adopt a definition of "average power factor." An obvious one is "the time average of all the values assumed by the power factor over a given period, such as could be obtained from a graph drawn by a graphic recording power-factor indicator." But this is inadmissible in practice for tariff purposes, because it is necessary to weight the average according to the magnitude of the loads at which the various values of the power factor occur. The most logical method of obtaining a "weighted mean power factor" is one derived from the definition of invariable power factor as the ratio watts/volt-amperes. A simple extension of the idea involved in this ratio leads to the definition of average power factor which is usually adopted, *viz.*, watt-hours/volt-ampere-hours. The numerator and denominator of this ratio are the time integrals, respectively, of the true power and the apparent power over the interval of time for which the weighted mean power factor is required.

If a true kVA-hour meter is not employed, it is necessary to have recourse to some other expedient for the evaluation of the volt-ampere-hours. Two such expedients are at present more or less widely used, *viz.*, the use of a watt-hour meter

(cosine meter) in combination with a reactive component meter (sine meter) which is applicable to single-phase or polyphase systems; and the use of two single-phase watt-hour meters on the "two-wattmeter principle," applicable only to 3-phase balanced-load systems.

The value of the kVA-hours is then assumed to be that given by the following formulæ:—

$$\sqrt{(A^2+B^2)} \quad \ldots\ldots (1)$$

where A = registration on the cosine meter, and B = registration on the sine meter.

$$(L+R)\sqrt{\left\{1+3\left(\frac{R-L}{R+L}\right)^2\right\}} \quad \ldots\ldots (2)$$

where L = registration on one meter, and R = registration on the other meter.

Now formula (1), when applied to 3-phase systems, involves the vector-sum definition of apparent power, which has been contended to be inequitable for tariff purposes. In addition, formula (1), both for single-phase and polyphase systems, and formula (2) are open to the grave objection that they always give some quantity which is less than the true kVA-hours, except in the one particular case in which the power factor remains absolutely invariable throughout the period of time under consideration.

Whether the error will be large or small depends on the amount of variation of the power factor. It may be contended that the possibility of error does not necessarily condemn the sine-cosine meter combination, for two reasons: first, in cases where the power-factor variation is small the error will not be appreciable; and second, in spite of the admitted departure from complete theoretical accuracy, the sine-cosine meter system may still be useful for a special tariff based upon some sort of indefinite "average power factor." These considerations apply with exactly equal force to two single-phase meters in combination on a 3-phase balanced load. The question of accepting or rejecting these methods of metering must remain a matter for the judgment of each supply authority, according to the circumstances governing the conditions of its supply.

In the curves shown in fig. 1 the excess of the true kVA-hours over the values calculated from formulæ (1) and (2) is expressed as a percentage of the true value, and the values of this percentage error are the ordinates of the curves, the abscissæ being the angular differences which express the difference between the values of the power factor for two periods of time. The errors depend solely upon the angular difference and not upon the absolute values of the two power factors. Thus the error would be precisely the same for two periods with power factors 1.0 and 0.5, respectively, as for two periods with power factors 0.866 and zero, since the angular difference is in each case 60 deg. In general, for intervals of time split into two part-periods, if the true kVA-hours for the first part-period at a constant power factor $\cos\phi_1$ are x, and for the second part-period at a constant power factor $\cos\phi_2$ are kx, and if the difference between the two power factors is expressed by $(\phi_2-\phi_1)$, and called θ, the kVA-hours for the whole period calculated from the formula $\sqrt{(A^2+B^2)}$ can be expressed also in terms of x, k, and θ by the formula

$$x\sqrt{(1+2k\cos\theta+k^2)} \quad \ldots\ldots (3)$$

the true kVA-hours being

$$x(1+k) \quad \ldots\ldots (4)$$

For all values of k, when θ is zero, the error is zero; and for any value of θ, when $k=1$, the error is maximum. The curves are set out for such two part-periods and for various values of k, over the whole range of power-factor variation from zero (lagging) to zero (leading). The maximum possible error, 100 per cent., is that given by curve A for which $k=1$, at the point where $\theta=180$ deg. As an example of the determination of the error from the curves for any particular case, suppose a period of time divided into two parts, the first, two hours with a load of 100 kVA (*i.e.*, 200 kVA-hours) at power factor 0.95 (lagging); and the second, 40 hours with a load of 10 kVA (*i.e.*, 400 kVA-hours) at power factor 0.4 (lagging). The value of k is 400/200=2.0. The value of θ is (66 deg. 25′−18 deg. 11′)=48 deg. 14′.

From curve G, for an angular difference of 48 deg. 14′ the magnitude of the error is found to be 7.7 per cent. Inspection of the curves shows that under all conditions the error is negligible (being under 2 per cent.) for power factors having angular differences less than 20 deg, *i.e.*, for power factors whose values, for example, do not vary outsidee the limits 0.985 lagging and 0.985 leading, or 0.34 and 0 both lagging or both leading, the former giving the smallest and the latter the largest numerical difference in the values of the power factor for the angle chosen, *viz.*, 20 deg. In the neighbourhood of unity power factor, merely small differences in the power factor correspond to relatively large angular differences and consequently give rise to the possibility of large errors.

An examination of current practice in the measurement of kVA demand in polyphase circuits shows that the following classification may be adopted for the various kinds of instruments chiefly in use.

Group I (*Vector-sum type*).

(*a*) Watt-hour meters with "over-lagged" shunt circuit fluxes, or energised from special potential transformers with "lagged" pressures.

(*b*) Combination of cosine and sine component meters linked by rotating sphere to obtain the hypotenuse of the energy triangle.

(*c*) Cosine and sine component meters compounded by selective differentials leading to an integrator which is advanced by the fastest combination of the two components.

Group II (*Arithmetic-sum type*).

(*d*) Thermal ampere-demand type.

(*e*) Induction ampere-demand type—shaded-pole motor pattern.

(*f*) Induction volt-ampere demand type—shaded-pole motor pattern with voltage compensator.

The author would not advocate the use of Group I instruments except under conditions of approximately balanced power factors.

The Cable-Wireless Merger.

Particulars of the Two New Companies.

THE following supplements the brief information regarding the merging of the wireless and cable systems which appeared in our last issue. The holding company—"Cables and Wireless, Ltd."—although its nominal capital is only £100, is empowered to raise it to £53,700,000 by ordinary resolution. This enlarged capital will be divided into £1 shares as follows: 23,500,000 5½ per cent. cumulative preference shares; 21,200,000 7½ per cent. non-cumulative "A" ordinary shares; and 9,000,000 "B" ordinary shares. The company is to acquire the present or future stocks, shares, debentures, and other securities of the Eastern Telegraph Co., Ltd., the Eastern Extension, Australasia and China Telegraph Co., Ltd., the Western Telegraph Co., Ltd., and Marconi's Wireless Telegraph Co., Ltd., and of any other present or future companies whose objects include the owning and operation of communication systems (including television and broadcasting), the generation, supply, &c., of electricity, or carrying on the business of transport. It is also to guarantee the performance of all or any of the obligations or engagements of such bodies to H.M. Government or other authority and to recoup the constituent companies the costs of the negotiations which have led up to the merger, &c. The articles stipulate that the control shall remain in British hands, not more than 25 per cent. of the capital being allowed to be held by foreigners; only British subjects can be directors of the company. Compensation to a maximum of £25,000 can be paid to directors of the constituent companies who are adversely affected by the merger. The first directors are Sir Charles A. Addis, Mr. F. R. S. Balfour, Sir Charles C. Parrie, Sir Frederick J. Barthorpe, the Earl of Bessborough, Sir Pasil P. Blackett, Col. the Hon. A. G. Broderick, the Earl of Clarendon, Mr. J. C. Denison-Pender, Admiral H. W. Grant, Mr. H. C. Hambo, Viscount Inchcape, Lord Inverforth, Mr. F. A. Johnston, Mr. F. G. Kellaway, Major H. Lefroy, Senatore G. Marconi, the Earl of Middleton, Mr. J. F. O'Malley, the Hon. G. Peel, Dr. L. G. Sherlock, and Lord Wester Wemyss. Lord Clarendon and Sir Basil Blackett are directors approved by the Government.

The objects of the other company—"Imperial and International Communications, Ltd."—are to acquire the whole or parts of the companies mentioned or companies owned by them, and to take over the assets and obligations of the Pacific Cable Board (including those relating to the West Indian cable and wireless system), the Imperial Transatlantic Cables and the "Beam" system. The directors are the same as those of Cables and Wireless, Ltd., and similar provisions are made for the retention of control in British hands.

Mr. Edward Wilshaw is manager and secretary of both companies, and the registered offices are at Electra House, Moorgate, E.C.2.

At the first courts of directors held last week it decided to offer the stock and shareholders of the constituent companies, shares in Cables and Wireless, Ltd., in exchange for their holdings on the following basis:—

As regards the three cable companies:—Each £100 of ordinary stock in the Eastern Telegraph Co., or each £100 of ordinary shares of £10 each in the Eastern Extension Co., or each £100 of ordinary shares of £10 each in the Western Telegraph Co.: £165 of 5½ per cent. cumulative preference shares of £1 each; £108 18s. of 7½ per cent. non-cumulative "A" ordinary shares of £1 each; and £26 of "B" ordinary shares of £1 each.

As regards Marconi's Wireless Telegraph Co., Ltd.:—Each

£100 (nominal value) of 7 per cent. cumulative participating preference shares of £1 each (*i.e.*, 100 shares), or each £100 of ordinary shares of £1 each (*i.e.*, 100 shares): £131 10s. of 5½ per cent. cumulative preference shares; £205 8s. of 7½ per cent. non-cumulative "A" ordinary shares; and £150 5s. of "B" ordinary shares. Each £50 of ordinary shares of 10s. each (*i.e.*, 100 shares): £81 10s. of 5½ per cent. cumulative preference shares; £205 8s. of 7½ per cent. non-cumulative "A" ordinary shares; and £150 5s. of "B" ordinary shares.

Where the exchange of the total amount of the stock or shares would involve the issue of a fraction of a share, a cash payment calculated at the par value of such fraction will be substituted for the fraction. It is hoped to make the definitive offer to the stockholders and shareholders about the end of April. The offer when made will be conditional on its acceptance within a stated time by the holders of a specified majority of the stock or shares in each of the four companies. The directors warn intending purchasers of stock or shares that not more than 25 per cent. of the issued shares of any class may be held by, or in trust for, or in any way under the control of, foreigners, foreign corporations, or corporations under foreign control, and that if it is at any time found that this limit is exceeded the directors may bring the foreign holdings down to the limit by selecting any shares which come within the foregoing category and requiring the holders thereof to transfer them to properly qualified persons.

Following upon the announcement, the holders of the Marconi Company's preference and £1 ordinary shares formed protective committees to deal with what they consider an injustice. Their contention is that they should receive exactly double the value of merger shares received by the holders of the company's 10s. ordinary shares. They claim that this is what would have happened if the normal method had been adopted of selling the assets of the Marconi Company for shares in the merger company and distributing those shares in a winding-up among the Marconi shareholders according to their legal rights. They consider that the only disadvantage to the shareholders who do not accept the offer would be a restricted market for their shares.

"Arrangements are, however, under consideration, by which £1 ordinary and £1 preference shares may be deposited under a trust agreement with the Prudential Assurance Company, as depositories. The depositories would issue to the depositors of £1 shares of both classes their own certificates, all ranking *pari passu*. These certificates would entitle the holders (subject to deduction of nominal expenses) to receive proportionately all revenue and all capital that may be received by the depositories in respect of the Marconi shares deposited. As the £1 ordinary shares and the preference shares stand at a price considerably in excess of their nominal value, it is proposed that four units shall be issued for each £1 share deposited. By this arrangement the non-assenting £1 ordinary and preference shares would, in effect, be amalgamated and split into four shares each, and the number of units represented by the certificates should be so large as to ensure a free market."

Meetings of the two classes of shareholders were to be held on Wednesday last to consider the position.

It should be noted that the £1 ordinary shares are the results of the exercise of conversion rights by debenture-holders who were thus not affected by the writing down of the existing ordinary shares from £1 to 10s. in 1927.

In the course of a statement issued from Electra House on Monday last it was stated that Cables and Wireless, Ltd., would hold all or nearly all the shares in the old cable companies and the Marconi Company. All the communication assets held by the cable and Marconi companies would be transferred to the Communications Company in exchange for shares in that company. Although the preference shares of the Eastern Company and the debenture stock of all three cable companies would continue to be held directly by the public, both the old cable companies and the Marconi Company would, in fact, have little more than formal existence under the new *régime*.

High-voltage D.C. Generators.

Notes on the manufacture of high-pressure direct-current machinery in Germany for use in wireless transmission stations and laboratories.

THE increasing importance of high-voltage direct-current machines in recent years for use as valve anode-current generators and in wireless transmission work has induced a number of makers at home and abroad to take up their manufacture, and amongst the earliest of such firms in Germany was the Bayerische Elektricitäts Werke, of Munich. Fig. 1 shows one of its h.p. generators as used at the Kaiserslautern transmission station. It is a 16-kW, 4,500-volt, 1,440-r.p.m. machine, and is shown with the protective end covers removed. In spite of the comparatively large output, the machine is a 2-pole one. The armature contains two distinct windings, the coils are former wound, and the whole insulation, to withstand a test pressure to earth of 10,000 volts, is placed in the slots. The commutators are small and solidly built, and, owing to the 2-pole construction, have a comparatively small voltage between segments (under 50 volts). The mica separators are only 0.025 inch thick. Special care is taken to avoid breakages of the commutator connections. The complete weight of the machine is 1,575 lb., showing that the 2-pole construction does not, necessarily, involve excessive weight. At the same time it ensures ample clearance between the brushes of opposite polarity. Commutating poles are provided, and the windings on these are connected in front of the two armature windings so as to act as protection for the latter against voltage surges.

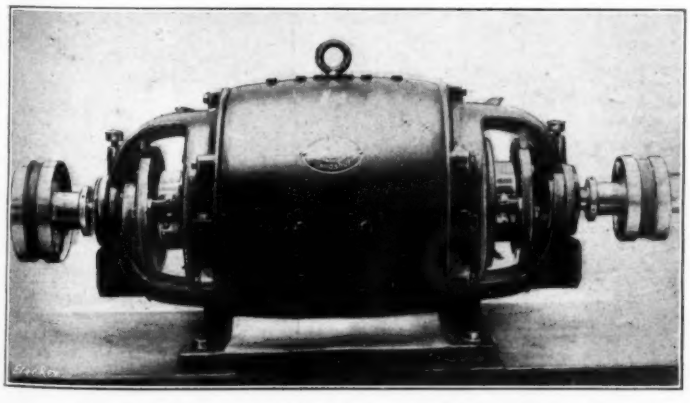


Fig. 1.—A Two-pole 16-kW, 4,500-V D.C. Generator.

The end covers are hinged in such a manner that, when open, they break the exciting circuit and so make it impossible to touch the working parts when they are alive. The field winding is protected against high voltage rises on switching off by suitable condenser-resistance by-pass circuits. Sometimes the two armatures are in entirely separate machines, and double generators of this type have been built for 10,000 volts in sizes as small as 3 kW.

Another interesting arrangement is shown in fig. 2; it consists of a drip-proof induction motor driving a drip-proof h.p. generator of 3 kW at 3,000 volts and 2,940 r.p.m. A fan, seen on the right of the photograph, is arranged to draw cooling air through both motor and generator and to discharge it through the grid shown in the side of the bedplate.

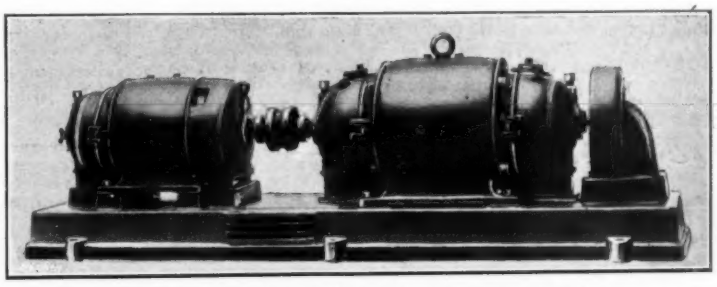


Fig. 2.—A 3-kW, 3,000-V Motor-generator Set.

Combinations of all kinds of high- and low-pressure generators can be arranged, either as a number of separate machines

coupled together on a bedplate or in the form of single multi-commutator machines. One of the latter is shown in fig. 3. This gives three distinct direct-current voltages—high, medium and low—and also has a pair of slip rings to deliver 50-cycle

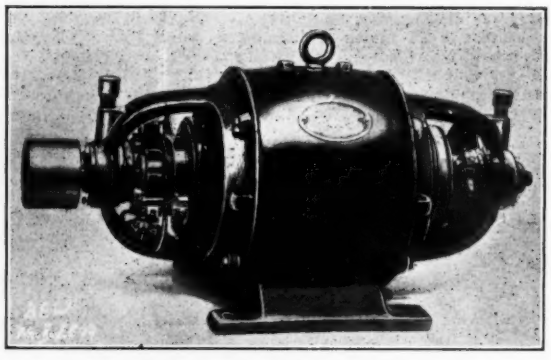


Fig. 3.—A Multi-Commutator D.C. & A.C. Generator.

alternating current. There is, further, a separate stator winding giving an a.c. output at 800 cycles. The machine is intended for engine driving in this case.

Legal.

The Gasfilled Lamp Patent.

In the Chancery Division on April 9th, on the application of the British Thomson-Houston Co., Ltd., Mr. Justice Luxmoore fixed May 1st for the hearing of the company's application for an extension of the period of its patent for the gasfilled electric lamp. Mr. Whitehead, K.C., for the applicants, said that notice of opposition had been given by eight parties.

Cooper Roller Bearings Co., Ltd., v. Power Plant Co., Ltd.

The proceedings in this action, the hearing of which occupied over three weeks, were briefly reported in our issue of April 5th (p. 636). On April 12th Mr. Justice Talbot delivered his reserved judgment. The plaintiffs claimed £833 for the price of goods sold and delivered and work and labour done. The question in dispute was whether certain friction clutches supplied by the plaintiffs for use in connection with machinery at tinplate rolling mills and other works were in accordance with contract or not. The contention of the defendants was that the clutches supplied by the plaintiffs were unsuitable, and that plaintiffs had committed breaches of contract and warranty. The plaintiffs maintained that the clutches were not able to perform their functions properly because of lack of adequate electric power supply.

Mr. Justice Talbot said the action was brought in connection with various contracts made between plaintiffs and defendants for the supply of clutches to be used with plant supplied by defendants to customers of theirs. In one case it was some rolling mills belonging to the Grovesend Tinplate Co.; in another to tube mills of the Eastwood Cement Company, Cambridgeshire; in another case to the rolling mills of the Elba Tinplate Company in South Wales; and there was a fourth contract in respect of which defendants had admitted liability and paid a sum into court. The first question was whether the goods were supplied and the work done by defendants' order and request. Plaintiffs alleged verbal orders and alternatively relied on the correspondence. The Grovesend clutches were delivered in January, 1926. Plaintiffs did not know for what mills they were required, or where they were in fact to be installed. On January 1st, 1927, the plaintiff firm heard from defendants that the clutches had broken down. Thereafter for many months plaintiffs were supplying appliances, chiefly plates, to replace those broken, and paying repeated visits to the Grovesend works in order to get at what was wrong. The Grovesend company had fixed the rated horse-power of the motors ultimately at 150. Defendants contracted to supply the driving and starting gear, including the motors and clutches. The clutches being part of the plant supplied by the defendants, when difficulty arose the Grovesend company applied to the defendants, and it was their business to deal with the matter. He was clearly of opinion that it was in giving such help and endeavouring to overcome the difficulties at defendants' request that the goods were supplied and the work done. The question of liability did not appear to have been raised till May, 1927, and it was only when it became evident that the sum involved had become considerable that it occurred to anyone that an understanding was necessary. After correspondence it was decided to let matters remain as before, and that the question of liability should be settled later. The burden of proving that there was a breach of contract was on the defendants, and therefore it had to be ascertained what was the contract under which the clutches were supplied. Previous orders for clutches had been on the basis that they should transmit 150 per cent. above the normal horse-power. It was obvious on this basis that the efficiency of the clutch depended on whether the horse-power was sufficient, a matter of which plaintiffs had no knowledge, and which was uncontrolled by them. It was evident that the defendants were thoroughly satisfied with the plaintiffs' clutches, and relied on their experience. It seemed plain that the defendants ordered on their own responsibility clutches of a capacity substantially greater than the horse-power of the motor. He was satisfied that this routine or practice was derived from and based on an earlier contract at Bryngwyn, which was thoroughly discussed, and that defendants impliedly represented to the plaintiffs that the conditions at the rolling mills in each case were not more severe in proportion to the power of the motor than those at Bryngwyn. When it was alleged by the defendants that plaintiffs had supplied clutches with plates which were too small a sharp difference of opinion arose between the parties. The defendants said they had given the plaintiffs all necessary information on which to quote for adequate clutches, but there was no question that plaintiffs were not in fact informed for what particular mills the clutches were required, and it was clear from the evidence that it would have been quite contrary to commercial practice, and also defendants' own practice, to give any such information. Having regard to the previous history of transactions between the parties, it seemed to him there was an overwhelming probability that the plaintiffs had fulfilled what was required of them. There was a strong presumption that either the motors adopted at the Grovesend works were not powerful enough, or there was something in the conditions, whether as to supply of power or pressure of the current or in the character of the duty itself which accounted for the difficulties experienced, and not anything in the design or construction of the clutches.

As to the size of the clutches defendants had entirely failed to prove they were too small. He thought it most improbable that the plates originally supplied were defective. With regard to the suggestion that plaintiffs should have ascertained the particular purpose for which the clutches were required, he did not know of any authority which laid that burden on them. So far as the Grovesend contract was concerned, in his opinion, the counter-claim failed.

It remained to consider both as to the claim and counter-claim the contracts relating to the Eastwood Company's mills and the Elba mills. Taking the latter first, the circumstances connected with the Elba works were practically the same as those of the Gravesend contract. In this case the plaintiffs were asked to supply transmission clutches capable of transmitting 150 h.p. above the rated h.p. of the motor specified. There was no evidence that plaintiffs failed to do that, and therefore plaintiffs were entitled to recover for goods supplied and work done in connection with those clutches, and were also entitled to judgment on the counter-claim so far as it related to this contract.

With regard to the Eastwood contract the complaint was that the clutch, soon after it was put in, "froze up" solid, and had been in that condition ever since. It appeared, however, that someone at the Eastwood Company's works locked up the clutch so that it could not be used as a clutch. It was difficult to ascertain what the real facts were owing to the lack of evidence from the Eastwood Company. The main complaint seemed to be that too much power was used by the clutch in accelerating the plant. It appeared to be established that there was great irregularity of voltage, but whether that accounted for all the complaints of the Eastwood Company it was impossible to say, and was not necessary to decide. It was enough to say that it had not been proved that plaintiffs broke the contract in the particulars alleged or in any other way. He thought plaintiffs had established a *primâ facie* case, subject to questions of amount, for the recovery of their whole bill. The onus of proving that any item was irrecoverable was on the defendants.

There would be no formal judgment entered now, but ultimately plaintiffs would be entitled to judgment on the claim and counter-claim with costs. He left the parties to move for judgment when the actual amount to which it was found after the reference they were entitled had been ascertained.

Mr. Pitt said he was instructed to apply for a stay of execution, but Mr. Justice Talbot said that that was not necessary.

Mr. Cyril Atkinson, K.C., said he should, in due course, after the amount had been determined by the Official Referee, apply for judgment for the plaintiffs on the claim and counter-claim with costs.

Johannesburg Compensation Claim Settled.

The *Cape Argus* states that two claims for compensation, each to the extent of £10,000, have been made against the Johannesburg City Council by dependents of two European electricians, Messrs. R. G. Urwin and J. Cleaves, who were killed in an accident at the switchboard in the municipal power station

last year. The dependents in each case are a widow and two children. Negotiations have, however, recently taken place between the solicitors for the plaintiffs, and the Council has agreed to a recommendation "that without prejudice a sum of £2,650 be offered in each case in full and final settlement."

False Pretences Charge.

At the Birmingham Police Court on April 9th, Arthur Ward, labourer, of Small Heath, was charged with being on enclosed premises for an unlawful purpose, and with attempting to obtain money by false pretences from two householders.

Mr. Pugh, prosecuting solicitor, said that on March 28th Ward called at several houses in Somerville Road, representing himself to be chief inspector of the Electricity Department.

Lord Ilkeston (Stipendiary) found Ward guilty of the two attempts to obtain money, and fined him 60s. and 10s. costs. On the first count he was discharged.

North Wales Power Co.'s Capital Reduction.

In the Chancery Division, on April 15th, Mr. Justice Maugham sanctioned a petition by the North Wales Power Co., Ltd., asking for a reduction of its capital.

Mr. Lionel Cohen, K.C., for the company, said the proposal was to cancel 10s. of each of the 383,813 issued ordinary £1 shares. The reduction was part of a scheme to reorganise the company with a view to raising fresh capital to enable it to carry out its duties under the new regional power arrangements. The company's capital was £1,000,000, divided into 500,000 each of ordinary and preference shares. Resolutions had been passed to sub-divide both classes of shares into 10s. shares, and converting the preference into ordinary shares. The capital would then be increased to the original amount by the creation of new ordinary shares of 10s. each. Among the terms involved in the reorganisation was one that the company should buy the hydro-electric undertaking of the Aluminium Corporation.

Zone Wireless Co., Ltd.

Mr Justice Maugham, in the Winding-up Court, on April 15th, made an order for the compulsory liquidation of the Zone Wireless Co., Ltd., on the petition of Marconi's Wireless and Telegraph Co., Ltd.

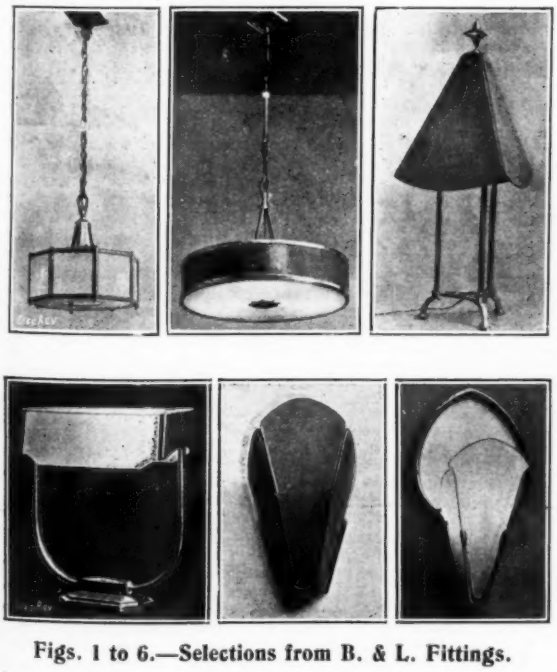
It was stated that the petitioners were creditors of the company for £162 under a contract.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

New Lighting Fittings.

The accompanying illustrations, figs. 1 to 6, are of selections from a range of lighting fittings recently marketed by Messrs. Best & Lloyd, Ltd., Handsworth, Birmingham. Many of these fittings are constructed with "Firelight" glass, which is coloured (standard) with a delicate orange merging into pale yellow, giving a very pleasant and becoming lighting effect. Various metal finishes can be supplied in oxidised brass, bronze, silver, and so on. Fig. 1 shows a one-lamp pendant fitting with obscured rimpled panes; the overall dimensions are 4 ft. long and 12 in. in diameter. The pendant fittings in fig. 2 is intended for three lamps



Figs. 1 to 6.—Selections from B. & L. Fittings.

and has a tinted vellum band, opal top glass and sandblast rimpled glass at the bottom. The fitting is 3 ft. 6 in. long and 20 in. in diameter. The table fittings shown in figs. 3 and 4 are each designed for one lamp, and are, respectively, 21½ in. and 12 in. high. The former is fitted with "Erinoid" panes and the latter with obscured rimpled panes. The wall fittings shown in figs. 5 and 6 are designed for one lamp each, having a projection of 4 in. and 4¾ in., respectively. The former is fitted with "Firelight" panes and the latter with obscured rimpled panes.

An Explosion-proof Lighting Fitting.

The continued demand for the more efficient illumination of situations in which explosive mixtures are prevalent has resulted in the development of the "Wigan" 100-W explosion-proof lighting fitting shown in fig. 8. The feature embodied to ensure safety are: (*a*) ample mechanical strength (to withstand the destructive effects of any internal explosion); and (*b*) a pressure-release device (so that there is no possibility of the ignition of external gases). The pressure developed is dependent upon the nature of the gases, and the fitting has successfully passed tests in methane-air, pentane-air, and acetone-air mixtures. The tests were carried out at the Sheffield University, forming the subject of certificates Nos. 227 and 243. The total number of explosions carried out on the sample fitting submitted was twenty-three,

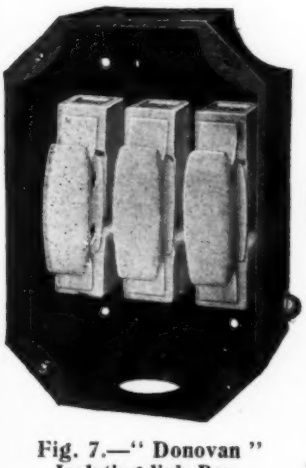


Fig. 7.—"Donovan" Isolating-link Box.

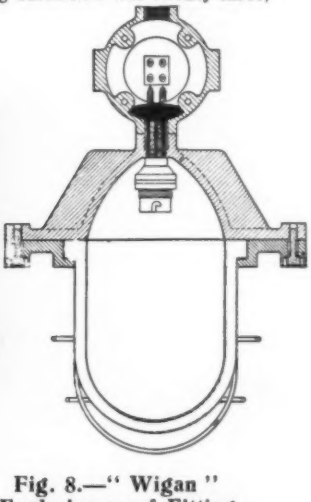


Fig. 8.—"Wigan" Explosion-proof Fitting.

without damage. The tests prove, it is claimed, the safety of these fittings when used in petrol depôts, cellulose works, mines, &c. The manufacturers, Messrs. Heyes & Co., Ltd., Water-Heyes Electrical Works, Wigan, will be pleased to forward full particulars to interested persons.

An Isolating-link Box.

An isolating-link box has recently been introduced by Messrs. Donovan & Co., 47, Cornwall Street, Birmingham, which, it is claimed, enables H.O. Regulation No. 11 to be fully complied with, in that efficient means of isolation can

be fitted within easy reach of the motor starter. The standard link box consists of a cast-iron case arranged to connect to 1¼-in. conduit at one end, and to conduit or to a starter or switch at the other end. Other types of cable entry can also be supplied.

Inside the case are fitted two or three porcelain-clad bases arranged to take cable up to 19/.064, fitted with hand-shield porcelain-clad removable links. The contacts are self-aligning. The electrical resistance of the links is so small that it approximates to 6 in. only of 19/.052 cable, and the power dissipation per link at 60 A is under ¼ watt. One size only is manufactured, up to 60 A, so that contractors and engineers can standardise this No. 1 size for all ordinary duty. Fig. 7 shows a 3-way box with the cover removed.

A Special Push Switch.

The "Klaxon Multum' push, fig. 9, a recent production of Klaxon, Ltd., 36, Blandford Street, W.1, has been specially designed for controlling alarm bells, hooters, and other electrical apparatus in mines, factories and other places where constant use calls for great strength and efficiency. It can

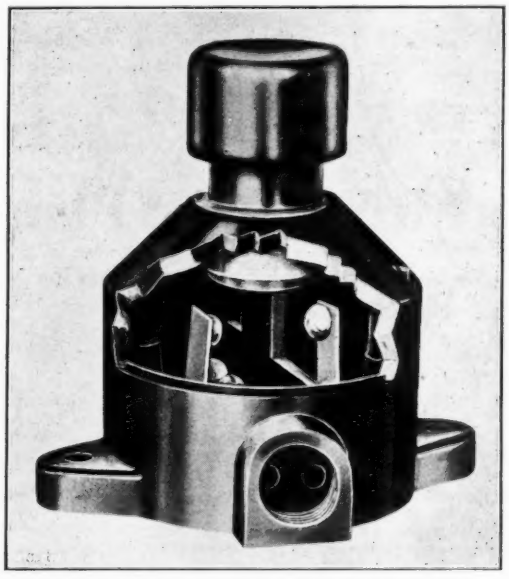


Fig. 9.—"Klaxon Multum" Push Switch.

be installed either permanently or for use in emergency only, and it will operate frequently and continuously, it is claimed, on circuits up to 500 volts, breaking 10 A at 110 volts. The capacity is high, and the contacts have sufficient mass to withstand considerable arcing while still maintaining good contact.

Indian Electrical Notes.

[By An Indian Correspondent.]

Ceylon.

TWELVE sub-stations in Colombo and the necessary machinery and equipment have been completed. Extra-high-pressure cables about 70 miles in length conveying power from the Kolonnawa power station have been laid in two rings serving practically the whole area of Colombo, each ring being supplied directly by two feeders. The steam plant at Kolonnawa was expected to be in full operation in February.

Calcutta.

Negotiations are proceeding between the Calcutta Municipality and the Calcutta Electric Supply Corporation, Ltd., regarding the prices charged for electricity in the city. The Supply Corporation is prepared to enter into a five-year agreement to charge 2.1 annas (2.36d.) per kWh for general lighting and 1.5 annas (1.68d.) per kWh for street lighting, with retrospective effect from January 1st, 1928. The Municipality, however, requires that the rate for general lighting shall be reduced to 2 annas (2¼d.) per kWh for a consumption of over one million kWh.

Madras.

After prolonged discussion the Corporation of Madras has decided upon the feasibility of the municipalisation of the electricity supply, instead of renewing the agreement with the Madras Electric Supply Corporation. Though it was pointed out that on a rough estimate it would require Rs.11 lakhs (£82,500) for the erection of suitable plant, and that the present finances of the Corporation would not permit of such a venture, it was thought by the majority necessary that municipalisation should be brought about.

The Mettur Project.

An agreement has been entered into between the Mysore and Madras Governments for the supply of electrical energy to the Mettur Project headworks now under construction by the Mysore Government. It is estimated that by purchasing power from Mysore instead of generating at the site as originally intended there will be a reduction of not less than Rs. 14 lakhs (£105,000) in capital expenditure and a further saving in the cost of power during the period of construction of about Rs. 10 lakhs (£75,000). The transmission line from Sivasamudram, the generating centre, to Mettur has been completed and the supply of energy has commenced. The line runs over 63 miles, mostly through thick forests and hilly tracts. The average demand is expected to be about 2,040 kW, available normally for about twelve hours a day.

Punjab.

Electricity is making great headway in the Punjab, and according to the latest report a number of towns are now electrically lighted. The Lahore Electric Supply Co. has been granted a licence for the supply of energy to Sialkot, and the new Lahore City sub-station of the company has been passed for operation. The company has also ordered a 300-kW set with boiler equipment for Amritsar. At Lyallpur considerable progress has been made in the installation of Diesel engines and the installation of distribution mains. At Gujranwalla two generating sets installed by the local electricity supply company have been augmented by a third set of 200 kW.

Mysore State.

Mysore leads the way among Indian States in the matter of electrification. During the past year there has been considerable activity in the extension of electric lighting schemes in the district areas of the State, and measures for instituting a chain of electrical installations in the remoter centres are being proceeded with. The power generated during the year at Mysore was 161,894,410 kWh. The maximum loads recorded were 17,860 h.p. for mining companies, 11,680 h.p. for industrial concerns, and 4,470 h.p. for street and house lighting.

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Cleaning Machinery.

There have been a number of advertisements of late for electric blowers, the purpose of which is to clean generators, &c., by means of compressed air. I have always been very much against this method of cleaning generator and motor windings, my reason being that while blowing quite a large amount of dust out of the machine one is also blowing dust into places from which one will not be able to get it again; in other words, one is blowing dust from one part of the machine to another. To my mind it is much better to use a strong type of vacuum cleaner, because with this type of cleaning one *does* know where the dust goes to. If proper fittings are used, it is no trouble to clean a machine much better than by blowing the dust about.

Charge Engineer.

April 13th, 1929.

Proposed Technical Society for Meter Engineers.

With reference to the formation of a new technical society on the lines of, and similar to, the old Meter Engineers' Technical Association, it has been suggested to me by several meter engineers that there is still room for a technical association as distinct from the Meter Section of the I.E.E.

It appears to be realised by meter engineers in general, as well as those of us who were transferred to the Meter Section of the I.E.E. on the fusion of the M.E.T.A. with the I.E.E., that the needs of the majority of the meter fraternity are not being catered for from a technical engineering standpoint. A review of the I.E.E. papers of the past four months supports this view, as little of interest to the meter engineer is contained therein, the proceedings being of a general electrical engineering character. A further point is that when meetings and discussions are held, many engineers who would attend are prevented from so doing on account of the distance.

I would suggest, therefore, that a new technical society be formed on the lines of the old M.E.T.A., but incorporating the group system, whereby meetings could be held by different sections of the Society throughout the country.

I shall be pleased to have the names of all meter engineers who would be willing to co-operate in the proposed schemes. Letters may be forwarded to me at the address below.

H. F. Hudson,
Graduate I.E.E.

Electricity Works, Hylton Road, Worcester.
April 13th, 1929.

Advertising Municipal Vacancies.

I should like the aid of your journal to call attention to the revivification of that one-time rampant disease, *viz.*, the advertising of vacant positions for which individuals are already earmarked.

A rather brazen sample of this procedure has recently been enacted by a municipality when two vacancies occurred.

It is doubtful if anyone really cares a straw about this give-preference-to-my-late-colleague, brotherly-love kind of stuff; in fact, the majority would no doubt be full of sympathy for those concerned who possibly may not be able to obtain a move on their merits.

I think, however, that I am reiterating the opinion of the multitude when I say that this hypocritical bunk which causes applicants to waste their time and money should cease.

The usual excuse that advertising is compulsory is too lame to toddle.

Fueleco.

April 15th, 1929.

[If it were not compulsory to advertise, might not the ground for grievance be thought to exist more extensively?—EDS. ELEC. REV.]

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1927.

24,877. "Negative secondary battery plates." D.P. Battery Co., Ltd., and J. Waddell. September 21st, 1927. (308,283.)

30,705. "Rotary electric switches." C. A. Turner. November 15th, 1927. (308,183.)

33,200. "Means for regulating the supply of current from dynamos having a third brush for use in power-driven vehicles." A. Muriel (legal representative of G. Fornaca (deceased)). December 8th, 1927. (308,286.)

34,182. "Circuit arrangements for embodying discharge tubes." S. G. S. Dicker Naamlooze Vennootschap Philips' Gloeilampenfabrieken. December 16th, 1927. (308,288.)

34,281. "Means for controlling electric hoists and elevators." P. McDermid and P. S. McDermid. December 19th, 1927. (308,184.)

34,297. "Junction boxes for metal-sheathed electric cables." Walsall Hardware Manufacturing Co., Ltd., and A. E. Read. Deecmber 19th, 1927. (308,185.)

34,322. "Electric switchgear." A. Reyrolle & Co., Ltd., and J. Mirrey. December 19th, 1927. (308,186.)

34,341. "Apparatus for rectifying alternating electric currents." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd. December 19th, 1927. (308,188.)

34,342. "Apparatus for rectifying alternating electric currents." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd. December 19th, 1927. (308,189.)

34,343. "Apparatus for rectifying alternating electric currents." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd December 19th, 1927. (308,190.)

34,362. "Regulating devices." International General Electric Co., Inc. December 24th, 1926. (282,676.)

34,534. "Electric contact-making and breaking devices and associated controlling and controlled means." Creed & Co., Ltd., F. G. Creed, and A. Orling. December 20th, 1927. (308,239.)

34,715. "Alternating-current electric machines." English Electric Co., Ltd., and R. D. Ball. December 22nd, 1927. (Cognate application, 23,883/28.) (308,335.)

34,737. "Two-way telephone and the like systems." W. S. Smith and N. W. McLachlan. December 22nd, 1927. (308,336.)

34,738. "Thermionic and the like amplifiers." W. S. Smith and N. W. McLachlan. December 22nd, 1927. (308,337.)

35,088. "Electric protective arrangements." A. Reyrolle & Co., Ltd., and B. H. Leeson. December 28th, 1927. (308,334.)

35,089. "Electric protective arrangements." A. Reyrolle & Co., Ltd., B. H. Leeson, and E. W. M. Scott. December 28th, 1927. (308,378.)

35,166. "Driving mechanism of electrically-driven paper machines and the like." Harland Engineering Co., Ltd., and F. G. Warburton. December 28th, 1927. (308,380.)

35,232. "Electric cable joint." T. Yamanouchi. December 29th, 1927. (308,381.)

35,260. "Means for generating electricity by evaporating liquids." F Von Brunner. December 29th, 1927. (308,382.)

35,376. "Electric time relays." Akt. Ges. Brown, Boveri et Cie. December 30th, 1926. (282,831.)

35,427. "Alternating-current dynamo-electric macaines." Sachsenwerk Licht-und- Kraft Akt. Ges. and T. Schmitz. December 31st, 1927. (308,384.)

1928.

16. "Dialling apparatus for automatic telephone instruments." C. A. Schierwater. January 2nd, 1928. (308,385.)

501. "Electric fuses." W. J. John and H. Wright, Junr. January 6th, 1928. (308,388.)

573. "Apparatus for the ultra-violet ray treatment of flour." S. Bonsor. January 7th, 1928. (308,390.)

880. "Electrical insulators." J. E. Pollak (Hermsdorf Schomburg Isolatoren Ges.). January 10th, 1928. (308,393.)

1,588. "Electric-current interrupters." Siemens Bros. & Co., Ltd., E. A. Petithorey, and E. R. Garrod. January 18th, 1928. (308,398.)

1,824. "Signalling devices for traffic-controlling purposes." Brighton Lighting and Electrical Engineering Co., Ltd., and E. Heaps. January 19th, 1928. (308,400.)

1,826. "Coin-freed prepayment mechanism for electricity meters." Smith Meters, Ltd., E. W. Smith, H. E. Angold, and A. W. Angold. January 19th, 1928. (308,401.)

2,688. "Electric transformers." British Thomson-Houston Co., Ltd., and J. G. Wellings. January 27th, 1928. (308,406.)

3,153. "Apparatus for illuminating the interiors of closed compartments." Walker, Hunter & Co., Ltd., and J. Walker. October 27th, 1928. (308,409.)

3,185. "Safety devices for electrical apparatus." British Thomson-Houston Co., Ltd. February 1st, 1927. (284,630.)

3,417. "Lead-sheathed electric cables." J. McCallum. February 3rd, 1928. (308,413.)

3,560. "Electric motors." British Thomson-Houston Co., Ltd., A. A. Pollock, J. Hutt, and A. G. Salisbury. February 4th, 1928. (308,416.)

4,637. "Electrical plug-and-socket coupling with longitudinally-divided sockets." M. Bing. February 14th, 1928. (308,425.)

5,446. "Magneto-electric machines." British Thomson-Houston Co., Ltd., and L. Griffiths. February 21st, 1928. (308,432.)

5,714. "Sparking plugs." B. Hopps and A. M. Lodge. February 23rd, 1928. (308,435.)

6,243. "Electrical signalling systems." General Electric Co., Ltd., and N. C. Smart. February 28th, 1928. (308,440.)

6,621. "Systems of protection and control for electrical distribution systems." British Thomson-Houston Co., Ltd. March 9th, 1927. (286,693.)

7,274. "Telephone instruments." Mullard Radio Valve Co., Ltd., and C. F. M. Hayes. March 8th, 1928. (308,448.)

7,275. "Telephone instruments." Mullard Radio Valve Co., Ltd., and C. F. M. Hayes. March 8th, 1928. (308,449.)

8,453. "Piezo-electric devices." Marconi's Wireless Telegraph Co., Ltd. March 21st, 1927. (287,484.)

8,693. "Sparking plug." F. Bolton. March 22nd, 1928. (308,472.)

9,235. "Electrodes for use in electric arc welding." Quasi-Arc Co., Ltd., and A. P. Strohmenger. March 27th, 1928. (308,475.)

9,277. "Electric switches." Harben's (Viscose Silk Manufacturers), Ltd., and W. E. Sharples. March 27th, 1928. (308,476.)

9,477. "Ram and connecting rod fitting particularly for electro-hydraulic steering gears." Brown Bros. & Co., Ltd., and W. Wallace. March 29th, 1928. (308,478.)

9,529. "Direction indicators for use on vehicles." Ceskomoravska-Kolben-Danek Akciova Spolecnost. April 1st, 1927. (288,150.)

10,152. "Hand magnifying glass with electric illumination between the lenses." J. Catwin (Merano Ges. Optik-Feinmechanik). April 4th, 1928. (Convention date not granted.) (288,302.)

11,086. "Wireless telegraphy and/or telephony." P. E. McIver. April 14th, 1928. (308,493.)

11,118. "Electric incandescent lamp fittings." R. P. A. Anderson. April 14th, 1928. (308,494.)

11,486. "Cases for electric condensers and other electrical components." Sterling Telephone & Electric Co., Ltd., and R. E. Miles. April 18th, 1928. (308,497.)

12,278. "Circuit arrangement for intermediate amplifiers in two-wire lines." Siemens & Halske Akt. Ges. June 18th, 1927. (292,461.)

12,973. "Device for directing or guiding tramway or other cars at rail junctions." I. Litvinshev. May 2nd, 1928. (308,505.)

13,310. "Methods of, and apparatus for, making electric incandescent lamps and similar articles." British Thomson-Houston Co., Ltd. May 7th, 1927. (290,165.)

13,516. "Electric call apparatus." C. Dupuis. June 3rd, 1927. (291,436.)

13,640. "Insulation and securing of coil windings of lacquered wire." J. Y. Johnson (I. G. Farbenindustrie Akt. Ges.). May 9th, 1926. (308,508.)

16,179. "Lead covering of electric cables and the like by extrusion." W. T. Henley's Telegraph Works Co., Ltd., and E. E. Judge. June 2nd, 1928. (308,521.)

16,876. "Thermionic apparatus." British Thomson-Houston Co., Ltd. July 19th, 1927. (294,168.)

17,841. "Holders for electric lamps." C. Baty. July 18th, 1927. (294,145.)

19,406. "Testing arrangements for electric networks." Ateliers de Constructions Electriques de Charleroi. July 13th, 1927. (293,831.)

21,866. "Impregnation material for use in electrical condensers." Telephon-Apparat-Fabrik E. Zwietusch & Co., Ges. October 29th, 1927. (299,697.)

28,024. "Directive aerials." N. Koomans. October 3rd, 1927. (298,131.)

29,105. "Railway and tramway rail joints." W. C. Fairweather (Ges. für Wirtschaftlichen-Bahnoberbau). October 10th, 1928. (308,555.)

29,689. "Piezo-electric devices." E. W. C. Russell. October 14th, 1927. (298,904.)

29,703. "Coin-freed prepayment mechanism for electricity meters." Smith Meters, Ltd., E. W. Smith H. E. Angold, and A. W. Angold. January 19th, 1928. (Divided application on 308,401.) (308,557.)

29,704. "Coin-freed prepayment mechanism for electricity meters." Smith Meters, Ltd., E. W. Smith, H. E. Angold, and A. W. Angold. January 19th, 1928. (Divided application on 308,401.) (308,558.)

30,957. "Voltage balancing for systems of electrical distribution." British Thomson-Houston Co., Ltd. October 27th, 1927. (299,465.)

34,782. "Radio transmitters." Telefunken Ges. für Drahtlose Telegraphie. November 24th, 1927. (301,326.)

35,085. "High-frequency circuit arrangements, thermionic-valve transmitters and the like." Telefunken Ges. für Drahtlose Telegraphie. December 29th, 1927. (303,150.)

1929.

4,435. "Rotary electric switches." C. A. Turner. November 15th, 1927. (Divided application on 308,183.) (308,241.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from April 10th :—

Allscott (lettering and design). No. 495,953. Class 8. Radio-telephonic apparatus and parts thereof.—J. Scott, trading as James Scott & Co., 56, Inglis Street, Dunfermline.

Univisaphon. No. 496,376. Class 8. Philosophical and scientific instruments and apparatus for useful purposes.—J. Good, 173-174, Finsbury Pavement House, Moorgate, E.C.2.

U.H. (lettering and design). No. 498,480. Class 8. Electrical batteries (not for medical purposes) and electrical transformers.—C. R. F. Hanson, trading as Hanson & Co., Building 191, Trading Estate, Slough.

Fairylite (lettering and design). No. 499,928. Class 8. Apparatus for displaying signs by means of light reflective surfaces.—Fairylites, Ltd., 32, Victoria Street, S.W.1.

Microficient. No. 500,220. All goods in Class 8.—Graham Farish, Ltd., 17, Masons Hill, Bromley, Kent.

Lathol. No. 500,070. Class 13. Portable electric torches.—Ever-Ready Co (Great Britain), Ltd., Hercules Place, Holloway, N.7.

Electrorad. No. 498,000. Class 18. Electric heating apparatus for buildings.—H. P. Barker, trading as the Electro-Gas Co., 100, Victoria Street, S.W.1.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ADDLESTONE.—50 houses for Chertsey U.D.C.; E. J. Castle, clerk, Council Offices, Chertsey.

ANNAN.—Re-erection (after fire) of Blackyett (mansion) for Col. Frederick M'Connel.

BARKING.—40 subsidy houses, Faircross Estate; E. Glenny and Son.

BEXLEY.—Additional 50 houses, Brampton Estate, for the U.D.C.; surveyor.

BRISTOL.—Municipal buildings, College Green site; Corporation Municipal Buildings Committee.

BROADSTAIRS.—Church, Dumpton; vicar of St. Peter's.

BURNLEY.—Housing schemes, north and east areas; borough surveyor.

CANTERBURY.—Restaurant, The Parade, for J. Lyons and Co., Ltd., London.

CARLISLE.—Pathological institution, Cumberland Infirmary, for the governors; H. E. Scarborough, architect, 22, Lowther Street. Offices, Caldewgate, for Carr & Co., Ltd.

COLCHESTER.—Workshops, rest rooms, office and store, Hythe Bridge Ironworks; F. W. Brackett & Co., Ltd.

COULSDON.—Refuse destructor; U.D.C. surveyor.

DARTFORD.—Extensions, 20-bed ward and operating theatre, Livingstone Hospital; secretary.

DOUGLAS (I.O.M.).—Fire station; borough engineer.

EASTBOURNE.—Hospital, for the Leaf Homœopathic Cottage Hospital; secretary.

EDINBURGH.—Cinema, for Blue Halls (Edinburgh), Ltd.; the secretary. Extensions at Castle Mills Works, for North British Rubber Co., Ltd.; F. E. B. Blanc, architect. Extension of George Heriots School; G. Reid, architect.

ELLESMERE PORT AND WHITBY.—Housing scheme (264), for the U.D.C.; T. W. Francis, clerk (returnable deposit of £5 5s.).

FIFESHIRE.—Church at Rosyth; the Rev. Arnold Boyd, Rosyth.

GLASGOW.—Warehouses at 227 to 233, Hope Street, for Watt Bros. (Glasgow and Edinburgh); the manager. Shops at Knightswood, for Anniesland Co-operative Society, Ltd.; the manager. School at King's Park, for Education Authority; clerk, Education Offices, Bath Street.

HESWALL (Cheshire).—Extension of branch Hospital; secretary, Royal Liverpool Children's Hospital.

HORNCHURCH.—Factory extensions, Ardleigh Green, for Stafford Allen & Sons, Ltd., Cowper Street, E.C.

HULL.—Heating and extensions, Mental Hospital; J. R. Preston, consulting engineer. Estate development, Bricknell Avenue; A. L. Windross & Partners.

ILKESTON.—Drill hall, Albert Street; Territorial Force Association.

INCE-IN-MAKERFIELD.—Housing scheme (44), for the U.D.C.; W. Thornley, architect, 46, Wallgate, Wigan (returnable deposit of £1 1s.).

IRISH FREE STATE (Lurgan, Co. Rosscommon).—Conversion of Workhouse into hospital for the Board of Guardians (£28,000); Ferguson & McIlveen, architects, Belfast.

IRLAM AND CADISHEAD.—Houses (50), for the U.D.C.; Brew Bros., builders, Cadishead.

KNUTSFORD (Cheshire).—Housing scheme (140), for the U.D.C.; surveyor.

LEEDS.—Cinema, lock-up shops, stores, &c., Wellington Road, New Wortley; West Leeds Amusements Co., Ltd. Warehouse, offices, &c., Bridge Road, Kirkstall; Thrift Stores, Ltd. Housing scheme (64), Meanwood Estate; J. E. Acfield, city engineer, Municipal Buildings.

LONDON (East Ham, E.).—Elementary school, Flanders Road; Education Committee. Depôt for London Co-operative Society, Ltd., Little Ilford Lane; A. Hulbert. 218 houses, Roman Road and Saxon Road; J. Stokes and Sons.

(Finchley, N.).—Cinema and dance hall, Ballards Lane; Ritz Cinemas & Entertainments Co., Ltd. Extensions, New Oak Road; Simm's Motor Units, Ltd.

(Fulham, S.W.).—Isolation accommodation, Western Hospital (£32,590); Metropolitan Asylums Board.

(S.W.17).—Extensions, Fountain Mental Hospital (£3,500); Metropolitan Asylums Board.

LYMINGTON.—Housing scheme (30), for the R.D.C.; R. O. L. Lovell, surveyor (returnable deposit of £2 2s.).

MACCLESFIELD.—Additional 100 houses, for the T.C.; borough surveyor.

MANCHESTER.—Baths and wash-houses, Hulme (£23,000); city engineer. Aerodrome, Chat Moss (£14,800); city engineer. Chapel, shelters and nursing accommodation, Baguley Sanatorium; Hospital Committee. Central laundry, Moss Side (£7,865); city engineer.

MATLOCK BATH.—Re-erection (after fire), of Royal Hotel; for R. J. Bray.

MITCHAM.—Church (£10,000), for the Congregational trustees; secretary.

MOTHERWELL.—Extensions, silk factory, for Anderson and Robertson.

NEWMILNS AND GREENHOLM.—Housing scheme (17), with electric wiring work, for the T.C.; J. H. Gilmour, burgh surveyor (tenders by April 22nd).

NORTHAMPTON.—Additional 40 houses, for the T.C.; borough surveyor. Estate development, Headlands Estate, Weston Favell; D. P. Taylor.

OLDHAM.—Sewage works, Foxdenton Lane, Chadderton (deposit £2 2s.); borough engineer, Town Hall.

OXFORD.—Church (£6,000), Headington, for the Wesleyan trustees; secretary.

PLYMOUTH.—Public school; Torneley & Rooke, architects. Extensions, confectionery works, Bucknell Street; Lear Bros. Secondary school for girls, Montpelier site; city architect. Development of Central Park (£130,000); city engineer.

PURLEY.—Secondary school (400 places), for Surrey E.C.; W. W. Finny, secretary, Kingston-on-Thames.

RICHMOND (Yorks.).—Business stores, Catterick, for the Co-operative Wholesale Society, Ltd., Manchester. Church, Catterick Camp, for the Presbyterian trustees.

ROTHERHAM.—Works extensions, Grange Mill Lane; A. Shardlow & Co., Ltd.

SHEFFIELD.—Housing scheme (112), Wisewood Estate (Scheme No. 3) (deposit £2); W. G. Davies, city architect. Public baths and wash-houses, Wincobank and Upperthorpe (£19,000); W. G. Davies, city architect.

SOUTHEND-ON-SEA.—Hospital, with electrical block (£111,000), for the executive committee of the new General Hospital; secretary, 44, Alexandra Street.

STALYBRIDGE.—107 houses, Hague site; J. Gerrard & Sons, Swinton, Manchester. Housing scheme (19 acres) off Brishes Road; borough engineer.

STOCKTON HEATH (Warrington).—Cinema, Walton Road, for the Mersey Cinemas, Ltd.; secretary.

SUNBURY.—Housing scheme (32), for the U.D.C.; surveyor.

SUNDERLAND.—Central schools (deposit £2 2s.); C. A. Clayton Green, architect, Barclay's Bank Chambers, Fawcett Street.

TORQUAY.—Housing scheme (15 acres) at Combe Pafford; borough engineer. Development of Hilly Estate, St. Marychurch; Mr. Steer.

WALLASEY.—Housing scheme (228), Leasowe Road Estate; borough surveyor.

WALSALL.—Housing scheme (16 acres) at Leamore; borough engineer.

WATFORD.—Covering open-air market (£4,200); borough engineer.

WHITBY.—Bazaar premises, St. Anne's Staith, for F. W. Woolworth & Co., Ltd., Kingsway, London.

WILTON.—Houses (36), for the T.C.; J. Whatley, builder.

WREXHAM.—Houses (36), for the T.C.; J. Gerrard & Sons, Ltd., builders, Swinton, Lancs.

YORK.—Extensions, newspaper offices, Coney Street; *Yorkshire Herald.* Development, Clifton Estate; Clifton Estate, Ltd.